JULY, 1960

TRAFFIC ENGINEERING

Program—40th Annual Meeting, ITE

New Horizons for Transit in Metropolitan Chicago

The Problem of the Amber Signal Light in Traffic Flow

Traffic Assignment to Street and Freeway Systems

Building a Second United States

INSTITUTE OF TRAFFIC ENGINEERS
ITE
FOUNDED 1930

ON - STREET

OR

OFF-STREET

PARK-O-METER PRODUCES PROFIT

Whether your city has on-street or off-street parking problems, Park-O-Meter can be utilized to produce profits.

Park-O-Meters are automatic and accurate. They can be adjusted *on the site* for time, rate and coin changes, thereby eliminating costly shop maintenance and overhead.

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City _____

State _____

P O M

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NEW! High Visibility Traffic Buttons Work to Protect Life...

Even in the rain!

Cast from impact-resistant Thiokol polysulfide-base material. Easy to install. Stay put for years. Add highway safety . . . night and day, fair weather and foul.

New THIO-LINE Traffic Buttons, composed of high visibility reflector glass beads embedded in durable THIOKOL liquid polysulfide polymer base material, have a raised dimension—insuring effectiveness even in weather which blanks out conventional markers.

Easy to install—THIO-LINE buttons are bonded in place in 10-60 minutes (depending on the temperature) over asphalt, concrete or brick by THIO-LINE liquid polymer-base adhesive with a grip like steel.

Long-lived—in six years of testing on busy California thoroughfares, 25,000 buttons of the THIO-LINE type have averaged 99.9% durability record. Life expectancy of THIO-LINE: 10 to 15 years on city streets compared to 2 months for paint and 6 months for plastic markers. 25 years on the open highway contrasted to 12 months for paint and 2 to 3 years for plastic.

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CHEMICAL CORPORATION
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In Canada: Naugatuck Chemicals Division, Dominion Rubber Co., Elmira, Ontario

*Registered trademark of the Thiokol Chemical Corporation for its liquid polymers, rocket propellants, plasticizers, and other chemical products.

THIOKOL CHEMICAL CORPORATION, Dept. TM-91
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Gentlemen: Please send me your technical bulletin describing characteristics and installation procedures on THIO-LINE TRAFFIC BUTTONS, and a list of distributors.

NAME _____ POSITION _____
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EAGLE'S NEW
12-INCH SIGNAL ADAPTER

modernizes existing traffic signals rapidly and inexpensively .... regardless of make.*

MODEL KB331
Patent Applied For

IT'S AS SIMPLE AS A. B. C!

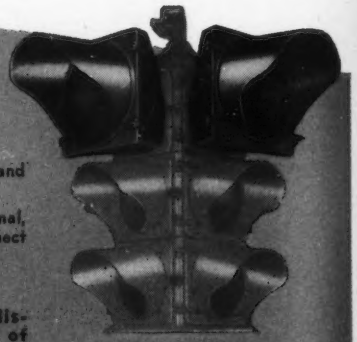
A Remove present 8-inch optics, including lens and visor. (Use the components for spares).

B Apply NEW adapter to door of your 8-inch signal, utilizing 4 tapped holes previously used to connect 8-inch visor.*

C Connect socket leads to terminal block.

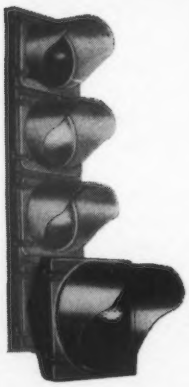
The installation eliminates all need for disassembly, rearrangement or replacement of brackets!

*Adaptable to all conventional 8-inch signal heads having square doors. Most installations will utilize holes previously used to attach visors. Fasteners and instructions furnished in kit for installations requiring the drilling of new holes.



Applies perfectly as your solution to 12-inch red indications on square, non-adjustable type signals.

Within Minutes YOU HAVE THE ADDED COMMAND OF MODERN 12-INCH SIGNAL INDICATIONS!



. . . with the superior features of all Eagle Traffic Signals, including —

- **Lightweight cast aluminum body.**
- **Stainless steel outside hardware.**
- **Dustproof and waterproof. Neoprene gasketing throughout.**
- **Adjustable lamp socket. Easily focused, yet held firmly in the plane of maximum efficiency.**
- **Same highly efficient optics.**

Applies neatly and effectively to all modern 8-inch traffic signals. Gives every indication of belonging . . . does not look tacked on! Advance plane of the adapter face gives added "punch" and aids in shielding the balance of the signal indications from overhead light reflection.

ADAPTABLE TO ANY NEED
. . . at the top as a 12-inch red.
. . . at the bottom as an arrow indication.

This new 12-inch signal adapter comes to you in one easy-to-install package, complete with 150 watt lamp. More often than not, all you'll need in addition is a screwdriver for installation.

Contact your nearest Eagle representative or mail coupon today!

EAGLE SIGNAL COMPANY, Municipal Division
Dept. TE-760, MOLINE, ILLINOIS

☐ Send Sales Representative for first-hand demonstration

☐ Send Prices & Best Delivery on _____ KB331 12-inch adapter kits.

NAME AND TITLE

ORGANIZATION

FULL ADDRESS

TRAFFIC ENGINEERING

OFFICIAL PUBLICATION OF THE INSTITUTE OF TRAFFIC ENGINEERS

Vol. 30 JULY, 1960 No. 10

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COVER: Chicago's Old Water Tower is one of the many landmarks that visitors to the 30th Annual ITE Meeting may see. Built in 1869, the tower withstood the ravages of the great fire which Mrs. O'Leary's cow started two years later. In the background is the famous 2-billion beam candlepower rotating aviation beacon atop the Palmolive Building.

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Frankly Speaking . . .

THE DECADE OF THE 1960's is a decade of decision for the traffic engineering profession. For the past four decades we have been founding our profession, developing its tools and perfecting the principles of movement as relates to traffic engineering—both in operation and planning.

The advent of the revised, expanded and improved Manual on Uniform Traffic Control Devices, which will be available to all of us within the year, confronts us with a decision—have we matured sufficiently to accept uniformity?

In the 1920's and 1930's our profession emerged out of a need for bringing order to vehicular movement. In the 1940's and 1950's this was expanded through the development of many working tools, through much experimentation and extended into the field of planning as well as operations. We have emerged from the 1950's with knowledge obtained through pooling of ideas from the local, regional and national level to the end that the 1960 National Manual on Uniform Traffic Control Devices is bringing to us the best of these practices.

We may not individually agree with each and every item in this manual, but now is the moment of decision when we must rise above petty idiosyncrasies and provincial ideologies. We must approach our profession, in a much broader perspective, for if we do not wish to be classed as a group of adolescents continually tinkering, we must start to show maturity through accepting the ideas of others.

This decade of decision then has been placed squarely in our laps and we must accept the responsibility and mature with it.

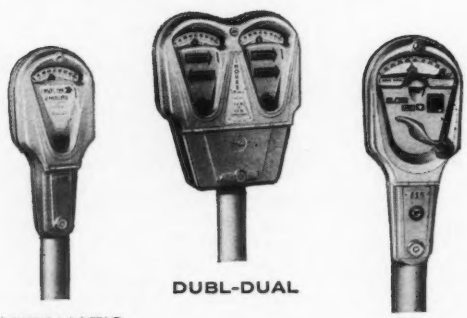
J. AL. HEAD
Director, District 6—ITE

GIVE YOUR MOTORISTS 50% MORE MANEUVERING SPACE WITH DUBL-DUALS

Rockwell Dubl-Dual parking meters insure a full *eight feet* to approach or leave a parking space. Other meter layouts allow only four feet for maneuvering and parking. Approach and exit are *safer* with the Dubl-Dual parking system, because traffic flow is smooth and fast. In one city, average parking time was reduced from 32 seconds to only 14 seconds. Parking time for women dropped from 37.4 seconds to only 15.9 seconds.

Dubl-Duals offer other key advantages . . . 23% lower initial cost, because two mechanisms are combined in one case; 50% lower installation costs, since only half as many meter stands are required; and lower maintenance costs, because two meters are checked at once.

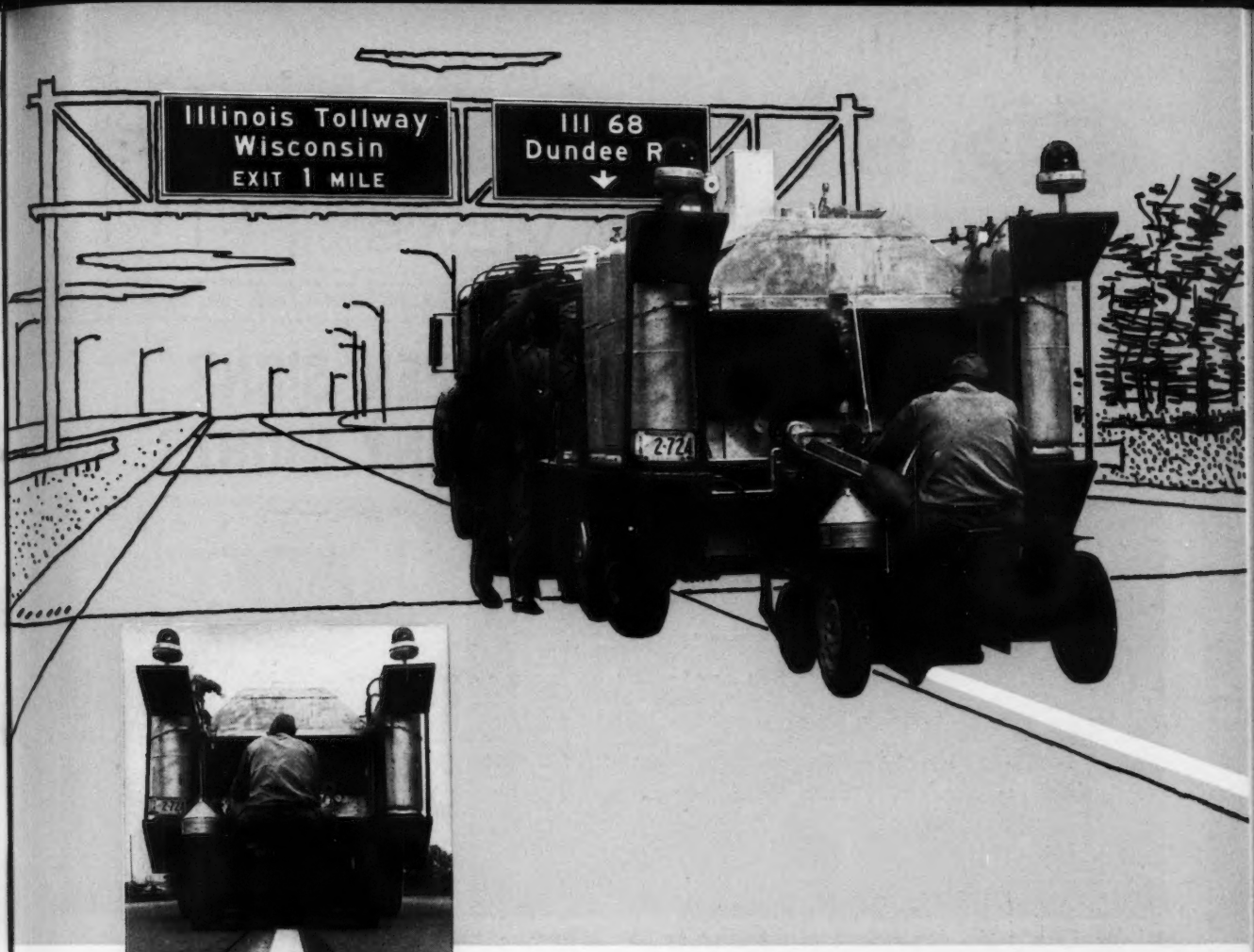
For additional information on the complete line of Rockwell automatic and manual parking meters, write: Dual Parking Meter Company, Subsidiary of Rockwell Manufacturing Co., Pittsburgh 8, Pa.



AUTOMATIC DUBL-DUAL MANUAL

The only complete line of automatic and manual parking meters

DUAL PARKING METERS
another fine product by
ROCKWELL



Cataphote crew lays long-lasting Catatherm on Eden's Expressway—Chicago.

Cleanly extruded Catatherm hits and bonds to pavement at approximately 400° F. Stripe is traffic-ready 3 to 6 minutes later.

Catatherm Reflective Thermoplastic Striping goes down easy . . . stays down longer

This is Eden's Expressway on Chicago's North Side . . . one of the world's busiest thoroughfares. Pavement markings of ordinary traffic paint have little chance of survival here.

To solve the problem of "short life" markings, the Illinois State Highway Department turned to Catatherm . . . Cataphote's reflective thermoplastic striping material. Composed of specially formulated thermoplastic resins, pigment and over 40% reflective traffic beads, Catatherm is hot extruded directly and securely onto any pavement . . . is available in white and yellow. Cataphote waterproof drop-on traffic beads, applied simultaneously with the extruding operation, provide immediate all-weather reflectance . . . add longer life to the stripe.

Catatherm can mean a brighter safety picture for *you* in the actual striping operation. Striping equipment at work creates a traffic hazard . . . the possibility of accident is always present. Drastically reduce restriping and this danger is virtually eliminated. You can do this with Catatherm . . . it outlasts good quality paint stripes from 9 to 26 times . . . saves plenty of maintenance dollars, too.

Pace setters in traffic control have recognized the advantages of Catatherm. Now, they "STRIPE IT . . . AND FORGET IT." Like to be a leader, too? Let us tell you more about Catatherm. Write for Catalog C-160.

CATAPHOTE CORPORATION

TOLEDO 10, OHIO / JACKSON, MISSISSIPPI

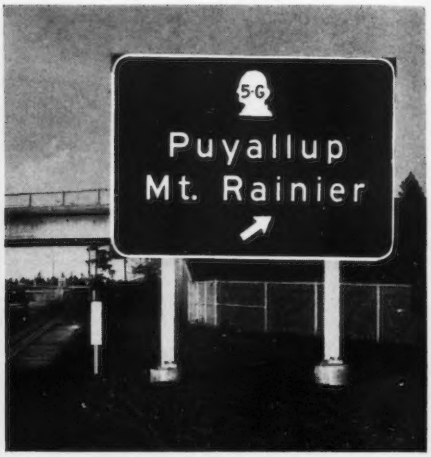
MANUFACTURERS OF REFLECTIVE TRAFFIC CONTROL PRODUCTS

3M COMPANY
Reflective Products

signing
NEWS AND VIEWS

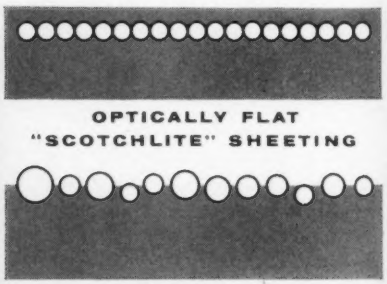
From the makers of "Scotchlite" Brand Reflective Sheeting, "Codit" Brand Reflective Liquid and other reflective products for modern traffic control and safety

WHY WASHINGTON'S GREEN SIGNS DON'T BLACK OUT ON RAINY NIGHTS



ALL-WEATHER reflective signing is as necessary as all-weather roads in the State of Washington. Above left is a guide sign on Interstate Highway 99, near Tacoma, photographed immediately after a rain. A film of water still covered the sign's face—but it had no visible effect on the brilliant performance of the signing material: "Scotchlite" Reflective Sheeting. Optically flat "Scotchlite" Sheeting is the long-time choice of the Washington State Highway Department for signs that *must* be seen in their true color and shape at all hours, in all kinds of weather.

HIGH ABOVE Washington's Interstate 99, overhead signs of green "Scotchlite" Reflective Sheeting are colorfully visible—come rain or clear skies. Green for guide signs is no newcomer to Washington. It was adopted for use on state roads over 5 years ago. Motorist reaction has been enthusiastic from the start.



SMOOTH-SURFACED "Scotchlite" Sheeting does not black out in the heaviest rain. Water will, however, alter the optical focus of exposed lens material, causing almost a total loss in reflection. For more details, ask your 3M Representative or write:

3M Co., Reflective Products Division, Dept. RBI-70, St. Paul 6, Minn.

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

THE TERMS "SCOTCHLITE" AND "CODIT" ARE REGISTERED TRADEMARKS OF THE 3M COMPANY

TECHNICAL PROGRAM

(Preliminary)

30th Annual Meeting Institute of Traffic Engineers

Edgewater Beach Hotel Chicago, Illinois

September 12-15, 1960

Monday, September 12 . . .

9:30 A.M. TECHNICAL SESSION No. 1

Edward G. Wetzel, *Presiding*

Welcome – Mr. Wetzel

"Traffic Developments in Chicago"

Presentation of Past Presidents' Award –
M. C. Sielski, Chairman, Award Committee

Past Presidents' Award Paper –
Winner to be announced

Presentation of Matson Memorial Award –
J. E. Havenner, Chairman, Award Committee

Theodore M. Matson Memorial Award Paper –
Winner to be announced

Noon KEYNOTE LUNCHEON

Howard Pyle, *Speaker*

2:00 P.M. TECHNICAL SESSION No. 2

Uses of Data in Research, Planning and Operations

A. F. Malo, *Presiding*

"The Theory of Traffic Flow"
Dr. Robert Herman
GM Research Laboratories

"Planning from an Overall Transportation Study"
J. Edward Johnston, Assistant Director
Utah State Highway Department

"Daily Use of Operational Surveillance"
Panel Discussion by Henry A. Barnes, Commissioner of Transit and Traffic, Baltimore; Eugene Maier, Director of Public Works, Houston; S. S. Taylor, General Manager, Department of Traffic, Los Angeles; and T. T. Wiley, Commissioner of Traffic, New York City.

Tuesday, September 13 . . .

9:00 A.M. TECHNICAL COMMITTEE MEETINGS

Departments 2, 3 and 7

9:00 A.M. TECHNICAL SESSION No. 3

Concurrent Department Meetings, Departments 4, 5 and 6

DEPARTMENT 4 –

Applications of Traffic Control Devices
S. Cass, *Presiding*

"Design and Signalization of a Diamond Interchange"
(Joint Meeting with Department 5)

"Centralized Traffic Signal Control by a General Purpose Computer"

"Warrants for Control Devices, Lighting and Medians"

DEPARTMENT 5 –

Geometric Design of Traffic and Terminal Facilities
C. J. Keese, *Presiding*

"Design and Signalization of a Diamond Interchange"
(Joint Meeting with Department 4)

"Parking in Relation to Expressways"

"Evaluation of Freeway Design and Operations"

DEPARTMENT 6 –

Transportation Planning
J. E. Johnston, *Presiding*

"Estimating Users' Costs in a Transportation Network"

"Land Use Related to Interchange Locations"

"Transit – A Rational Approach" (Panel)

1:30 P.M. TECHNICAL SESSION No. 4

Uniformity
C. W. Prisk, *Presiding*

"Highlights of Changes in the Manual on Uniform Traffic Control Devices"
Panel discussion by J. E. P. Darrell, Traffic Engineer, Minnesota Department of Highways; George W. Howie, Director of Utilities and Traffic, Cincinnati; Eugene Maier, Director of Public Works, Houston; and George

M. Webb, Traffic Engineer, California Division of Highways; E. H. Holmes, Assistant Commissioner for Research, Bureau of Public Roads, moderator.

2:30 P.M. ANNUAL BUSINESS MEETING OF THE INSTITUTE

Mr. Wetzel, *Presiding*

(Open to members of all grades)

Wednesday, September 14 . . .

9:00 A.M. TECHNICAL COMMITTEE MEETINGS

Departments 4, 5 and 6

9:00 A.M. TECHNICAL SESSION No. 5

Concurrent Department Meetings
Departments 2, 3 and 7

DEPARTMENT 2 —

Professional Standards, Education and Administration

C. C. Robinson, *Presiding*

"Making Your Organization Work"

(Symposium)

"Knowing Where You're Going"
"Giving Clear Signals"
"Positioning Responsibility"

"Current Research and Activities in Traffic Engineering Administration"

DEPARTMENT 3 —

Traffic Operations Measures

W. H. Clapproth, *Presiding*

"Railroad Grade Crossing Protection"
"Unbalanced Flow"

Discussion of papers prepared by several authors, summarized by a general reporter, and followed by audience discussion.

DEPARTMENT 7 —

Design and Standards for Devices, Equipment and Materials

Marble J. Hensley, *Presiding*

"Pedestrian Signals"
"Colors of Pedestrian Signals"
"Sign Illumination Techniques"
"Traffic Survey Devices"

2:00 P.M. TECHNICAL SESSION No. 6

Recent Accomplishments in Traffic Engineering

G. K. Gravelle, *Presiding*

"Effect of Lane Markings on Lane Usage"
"Traffic Diversion Study of an IHS Connection"
"The Traffic Engineer and the Industry Representative"
"Motorists' Services on Freeways"
"Presence Detector for Left Turning Vehicles"

Thursday, September 15 . . .

9:00 A.M. INFORMAL FIELD INSPECTION TRIPS
(as requested)

11:30 A.M. INSPECTION OF CONGRESS STREET EXPRESSWAY
via rapid transit train

2:00 P.M. INFORMAL FIELD INSPECTION TRIPS
(as requested)

MOTOR VEHICLE DEATHS AND CHANGES

	DEATHS				PERCENTAGE CHANGES				
					Corresponding Month			4 Months Moving Ave.*	
Months	1956	1958	1959	1960	1956-1960	1958-1959	1959-1960	1958-1959	1959-1960
January	2,954	2,709	2,790	2,900	— 2%		+ 4%		0%
February	2,652	2,398	2,430	2,380	—10%		— 2%		+1%
March	2,940	2,598	2,860	2,400	—18%		—16%		—3%
April	2,970	2,595	2,650	2,910	— 2%		+10%		—1%
4 Months	11,516	10,300	10,730	10,590	— 8%		— 1%		
May	3,094	2,937	3,110			+6%		+5%	
June	3,338	3,078	3,260			+6%		+6%	
July	3,555	3,098	3,250			+5%		+5%	
August	3,535	3,550	3,510			—1%		+4%	
September	3,653	3,325	3,360			+1%		+3%	
October	3,476	3,586	3,440			—4%		0%	
November	3,603	3,526	3,490			—1%		—1%	
December	3,858	3,581	3,650			+2%		—1%	
Total	39,628	36,981	37,800						

*Four Months Moving Average is based on changes between the total for four months instead of one month. For example, the April figure shows the change between the totals for January-April 1959 and January-April 1960, etc. Adding several months together tends to smooth out single month changes which may be affected by differences in the number of weekends in a month from one year to the next, random variations, etc.

All 1956 and 1958 figures are from the National Office of Vital Statistics.
The 1959 and 1960 figures are National Safety Council estimates.

New Horizons for Transit in Metropolitan Chicago

By Virgil E. Gunlock, Chairman
Chicago Transit Board

To meet the urgent transit needs of the Chicago metropolitan area, the Chicago Transit Authority recently presented a dramatic $400,000,000 program for extending and improving rapid transit, establishing Park-'N'-Ride garages and extending underground pedestrian passages in the central business district. Based principally upon coordination of the area's three major forms of transportation, mass transit, commuter railroads and private automobiles, the program calls for a combination of public and private financing to accomplish its objectives.

Estimated costs of the four parts of the program were given as follows:

Rapid transit extensions and equipment	$315,000,000
Park-'N'-Ride garages at CTA terminals	46,000,000
Park-'N'-Ride garages at suburban rail stations	30,000,000
Pedestrian way extensions in downtown area	5,500,000
Total	$396,500,000

The Chicago metropolitan complex embraces six counties totaling more than 3,500 square miles of which approximately 210 square miles are within the corporate boundaries of Chicago. The region's transactions in trade and commerce, and the value of the products from its vast array of industries, total billions of dollars annually.

World leadership is accorded the Chicago metropolitan area in many activities, including air transportation, truck transportation, rail transportation, steel production, electronic equipment manufacturing, mail order transactions, vocational training and diversified education, industrial research, conventions and trade shows. Chicago is also the hub of the nation's vast network of highways.

West Side subway—America's first combined rapid transit railway and automobile expressway has been in operation since June 22, 1958.

Area's Growth Rapid

Rapid expansion in trade and commerce, in industry, and in population is the order of the day. Approximately 15 billion dollars annually are being invested in new industrial plants, land, equipment and buildings. The area's population is increasing at the rate of 10,000 persons per month, but the most spectacular increase in population is occurring in the suburbs.

Park Forest, only a prairie in 1940, is now a city of 30,000, experiencing a population increase of more than 245 per cent since 1950. Since 1940, Skokie has had a population increase of 525 per cent; Niles, 580 per cent; Lincolnwood, more than 1,000 per cent; Arlington Heights, more than 250 per cent; Homewood, almost 175 per cent; Elmhurst, 125 per cent; Rolling Meadows, incorporated about three years ago, has approximately 8,000 people. All other suburbs have increased substantially, if not spectacularly.

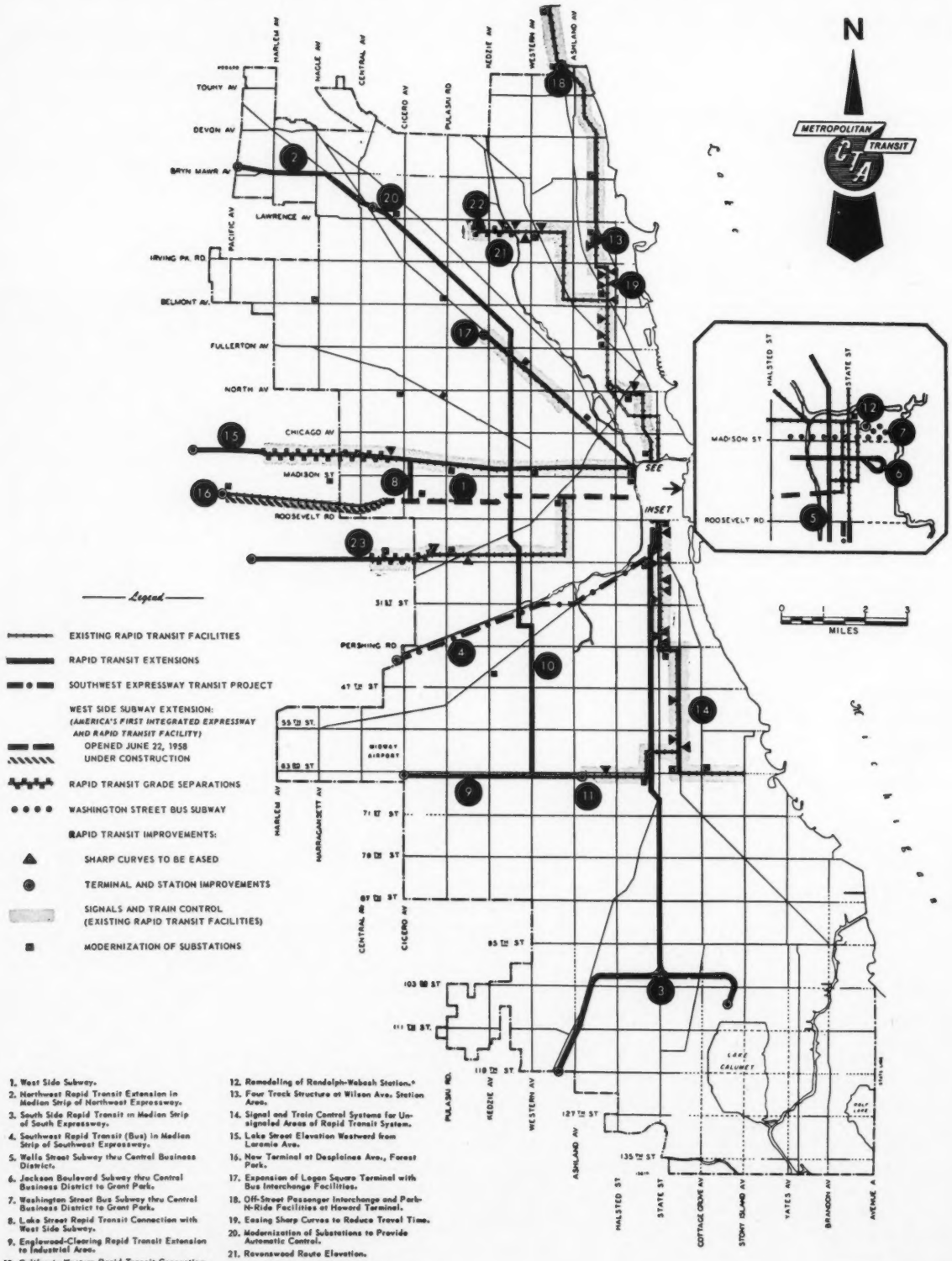
By 1970, it is estimated, the population of Chicagoland will reach 8,000,000—half of them Chicagoans, and the other half suburbanites.

Future Prospects

For metropolitan Chicago a new cycle of development and progress is underway, generated, as in the city's beginning, by water-borne commerce. With the opening of the St. Lawrence Seaway, it is anticipated that new industries stimulated by the seaway will pour millions of dollars into land, buildings and equipment in the metropolitan area. Thousands of new jobs will be created.

Within fifteen years, the value of the area's wholesale trade alone is expected to increase to twenty-two billion dollars a year from its present yearly total of sixteen and a half billion dollars. The anticipated economic stimulus from water-borne commerce will be exceeded if recently announced plans are carried out to spend thirty-seven and a half million dollars in improving Chicago's lakefront port facilities to supplement the seaway fa-

Proposed $315,000,000 — Twenty Year Transit Expansion and Improvement Program



1. West Side Subway.
2. Northwest Rapid Transit Extension in Median Strip of Northwest Expressway.
3. South Side Rapid Transit in Median Strip of South Expressway.
4. Southwest Rapid Transit (Bus) in Median Strip of Southwest Expressway.
5. Wells Street Subway thru Central Business District.
6. Jackson Boulevard Subway thru Central Business District to Grant Park.
7. Washington Street Bus Subway thru Central Business District to Grant Park.
8. Lake Street Rapid Transit Connection with West Side Subway.
9. Englewood-Clearing Rapid Transit Extension to Industrial Area.
10. California-Western Rapid Transit Connecting Northwest and Englewood-Clearing Routes.
11. Loomis Terminal Speed-Ramp Test Installation.*
12. Remodeling of Randolph-Wabash Station.*
13. Four Track Structure at Wilson Ave. Station Area.
14. Signal and Train Control Systems for Unsignaled Areas of Rapid Transit System.
15. Lake Street Elevation Westward from Laramie Ave.
16. New Terminal at Desplaines Ave., Forest Park.
17. Expansion of Logan Square Terminal with Bus Interchange Facilities.
18. Off-Street Passenger Interchange and Park-N-Ride Facilities at Howard Terminal.
19. Easing Sharp Curves to Reduce Travel Time.
20. Modernization of Substations to Provide Automatic Control.
21. Ravenswood Route Elevation.
22. Kimball Terminal Modernization.
23. Douglas Park Rapid Transit Elevation from Kenton to 54th Avenue and Extension to Harlem Avenue.

* Completed

T.E.D. 8-320
REV. 7-30-58 JOC

cilities now being completed in the Calumet region in the southeast corner of the city.

Transportation's All-Important Role

From Chicago's very beginning, transportation has played a leading role in the city's development, in the development of the metropolitan area, and in the development of the midwest heartland which the Chicago metropolitan area serves.

From its water-borne commerce, and the activities it generated, fledgling Chicago boomed rapidly into the metropolis of the western frontier. Then came the railroads, extending and expanding the boom begun by waterway commerce. Next came air transportation, and Chicago quickly became one of the world's busiest air terminals as well as the world's greatest railroad center.

Meanwhile, local transportation within the city was developing, and contributing its full share to the growth and prosperity of Chicago, and to the communities that mushroomed around the borders of Chicago. First it was the horse-drawn omnibus of pioneer Parmalee fame. Next came the horsecar, then the trolley car, the elevated rapid transit, and finally the motor bus and Chicago's first subways. The railroads, too, have long been important participants in the city's local and suburban transportation.

There is ample evidence of local transportation's priceless contribution to the economic progress of Chicago and the metropolitan area. In Chicago for example, there are at least 75 neighborhood communities and shopping centers that developed around transfer points or terminals of local transit routes. Beyond the city's boundaries, many communities can trace their origin to the accessibility provided by the railroads that spread fanwise from Chicago.

Over the years, transportation has added billions of dollars to the value of real estate in Chicago and the metropolitan area. Local transportation shares the credit for this achievement with its big brothers: water, rail and air transportation.

The Automotive Age

For many years, local transit prospered because it was without effective competition, but the advent of the automotive age shattered transit's monopoly. Now transit is fighting desperately against the severest of handicaps to maintain a service that is so indispensable to the welfare and progress of the community.

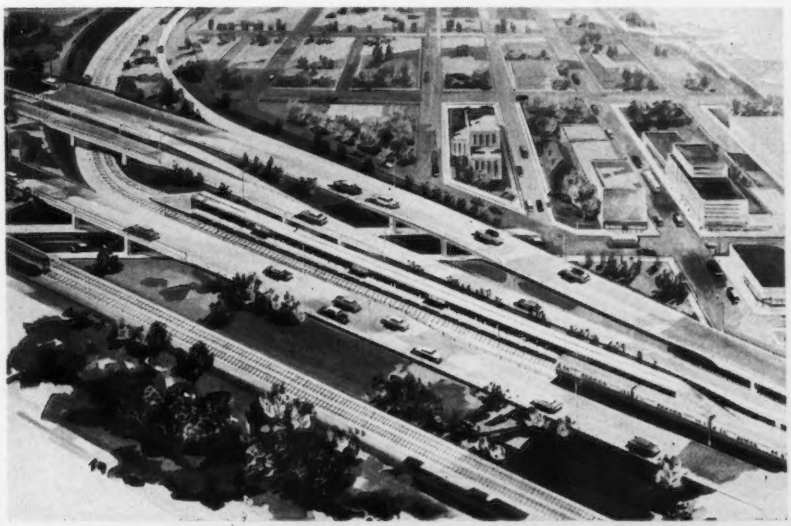
View is from a point north of Wilson avenue looking south at the intersection of Edens Expressway and Northwest Expressway with the proposed Park 'N' Ride garage located above the expressway intersection and illustrating the rapid transit facilities of Northwest Expressway passing under the Park 'N' Ride garage. The east and west street in the background is Montrose avenue and the east and west street in the foreground is Wilson avenue. Cicero avenue is to the right side of the illustration.

Competition from the private automobile has reduced transit's passenger volume in Chicago by more than 50 per cent in little more than 10 years. This loss of passengers to the private automobile began in the late '20's. During the period of World War II, when automobiles, tires and gasoline were rationed, transit came back again to peak volumes of traffic. When rationing ceased, however, automobile competition became more intense than ever, and it is continuing to increase in intensity.

Today there are almost one million passenger automobiles in Chicago compared with only 337,502 thirty years ago. In the last seven years, automobile registrations in Chicago have increased 30.5 per cent. The record shows graphically the relationship between transit passenger volume decline and the rapid rise in ownership and use of private automobiles.

Utter Chaos Without Transit

There are some observers who hold



View is looking south from a rapid transit station in the projected Northwest Expressway at Diversey and California avenues. It also illustrates a rapid transit turn-off into the median strip of the proposed Cross-Town Expressway. Rapid transit in the Northwest Expressway would be an extension of the Logan Square "L"-subway route northward between Talman and Rockwell avenues to the expressway right-of-way and then to a terminal near the northwest City Limits. Estimated cost, $31,000,000.

View is looking west at the intersection of Pulaski and Northwest Expressway and illustrates by cut-away the connections with the street at Pulaski road, the fare controls on the platform, and, in the background, the Irving Park boulevard entrances to the Pulaski-Irving station on the Northwest Expressway rapid transit.

that the private automobile can and should replace transit as a public carrier in our cities and metropolitan centers. It is their contention that transit has been outmoded by the automobile and should be permitted to fade out of existence.

On a normal weekday, approximately 1,000,000 people patronize CTA services, most of them taking two or more rides. If CTA ceased operating overnight, and the private automobile had to take over, there would be 600,000 more automobiles on the streets of Chicago than there are today. Such a floodtide of automobiles would choke all of the city's traffic arteries. The result, of course, would be utter chaos. Commerce and industry would be severely impaired; the whole economy of the city and surrounding area would be seriously harmed.

Obviously, the automobile cannot do transit's job. There simply is not enough money available to the city, to the county, and to the state, separately or together, even with the most generous Federal aid, to build the expressways, parking garages and parking lots that would be needed.

Neither can public transit alone provide the total transportation needs of a large urban center. This job, properly accomplished, requires co-ordination of all transportation facilities—the private automobile, the bus, grade-separated rail transit, and the commuter railroads, each performing its proper part. Only by such co-ordination can the utmost value be obtained for each dollar spent for urban transportation facilities.

This artist's sketch suggests the future possibility of terminal development at Desplaines avenue, Forest Park. It would include multi-story Park-'N'-Ride garage for thousands of automobiles. It would also have expanded rapid transit-bus undercover interchange facilities as well as easily accessible areas from expressways for wives driving their husbands to and from rapid transit terminal.

Chicago Pioneers in Combining Rapid Rail Transit with Motor Expressway

In Chicago there are classical examples of the "old" and "new" approaches to a solution of large city transportation problems. Stretching for miles along the lake front is the magnificent, multi-lane Outer Drive, which was built exclusively for automobiles. In rush hours, the Outer Drive is jammed to capacity, but there is no way to increase its capacity except by building a parallel expressway at tremendous cost.

The "new" approach is Chicago's West Side subway in the below street-grade right-of-way of the Congress Expressway. This is America's first combined rapid transit railway and motor expressway.

The new West Side subway was placed in service on June 22, 1958, from Chicago's Downtown Loop to Laramie Avenue, a distance of six and a half miles. The remaining section was placed in service on March 21, 1960, linking the suburb of Forest Park and the central business district of Chicago with completely grade-separated rapid rail transit.

Public Agency Co-operation Sets Pattern for the Future

Co-operative arrangements among five public agencies, the city of Chicago, the county of Cook, the state of Illinois, the Federal government and Chicago Transit Authority assured construction of the history-making West Side subway project and the Congress Expressway in which it is located.

The alignment established for the Congress Expressway necessitated removal of a substantial section of the structure of CTA's Garfield Park rapid transit route, use of underlying right-of-way for expressway roadways, and relocation of the entire route between the Loop and the west terminal in Forest Park.

The city of Chicago financed and constructed the West Side subway from its connection with the Milwaukee-Dearborn-Congress subway in the central business district to Laramie Avenue, and is also financing new terminal facilities in Forest Park to replace

CTA yard facilities at Laramie Avenue. Cook County and the state of Illinois constructed the subway extension between Laramie Avenue and the Forest Park terminal as their share of the responsibility for relocating the rapid transit route to clear the way for expressway construction.

Through their highway funds, four of the agencies, the Federal government, the state of Illinois, Cook County and the city of Chicago, contributed substantially to financing the cost of right-of-way, the increased length of local street overpass bridges, and drainage required for the West Side subway.

Construction of the expressway within the city limits was shared jointly by the city of Chicago, the county of Cook, and the state of Illinois. Beyond the city limits, the state and the county are sharing the cost. The Federal government is contributing Federal matching highway funds for the entire expressway project.

Integration of rail rapid transit with the Congress Expressway, in our opinion, marks the beginning of a new era in transit—an era in which automobiles and rapid transit will be coordinated so that each will perform the functions for which it is best suited, and each, working together, will complement the other.

We fervently hope that this friendly co-operation of public agencies, which produced this pioneering co-ordination of rapid transit and an automobile expressway, continues to the enduring benefit of all the people of the Chicago metropolitan area.

Chicago Will Build More Combined Transit-Expressway Facilities

Chicago is committed to the principle of combining rapid transit facilities with the grade-separated, multilane expressway projects now under construction or programmed for the immediate future—in the Northwest Expressway, which is now under construction; in the South Expressway, and in the Southwest Expressway.

Although financing for construction of rapid transit facilities in these expressways has not been arranged entirely, funds are being made available from a $10,000,000 city of Chicago bond issue for starting the integration of rapid transit with these expressways. These funds are paying for the engineering work and planning, and construction of certain transit items, to accompany highway construction.

View is from a point south of 63rd street looking northwest illustrating proposed Park 'N' Ride garage between 63rd and 59th streets, and connections between the existing Englewood elevated line and the Park 'N' Ride garage at about 59th street and illustrating connections of the South Expressway rapid transit and the Park 'N' Ride garage.

Chicago's Transit Needs

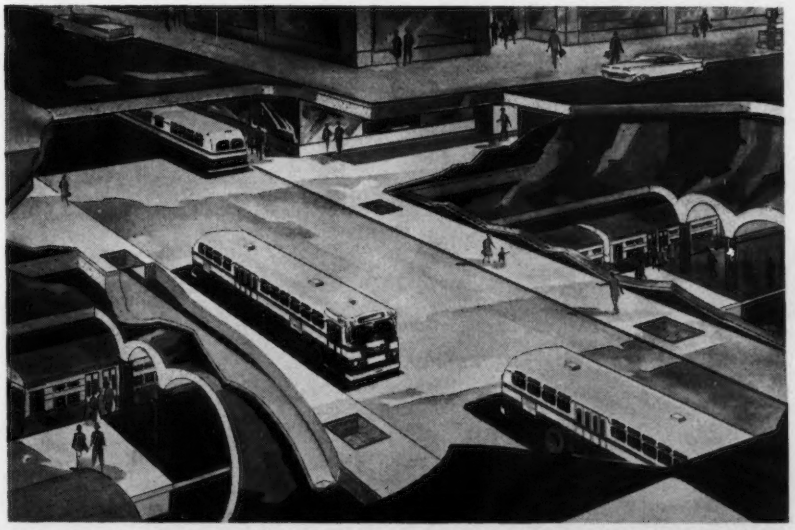
Integration and co-ordination of rapid transit with expressways and the suburban railroads are not by any means the complete answer to the transit needs of Chicago and the metropolitan area.

Public officials, civic leaders and metropolitan daily newspapers are generally agreed that the metropolitan area also urgently needs immediate expansion of off-street, grade-separated transit facilities, coupled with multi-story parking garages and extensive parking lots, located at outlying rapid transit stations and terminals.

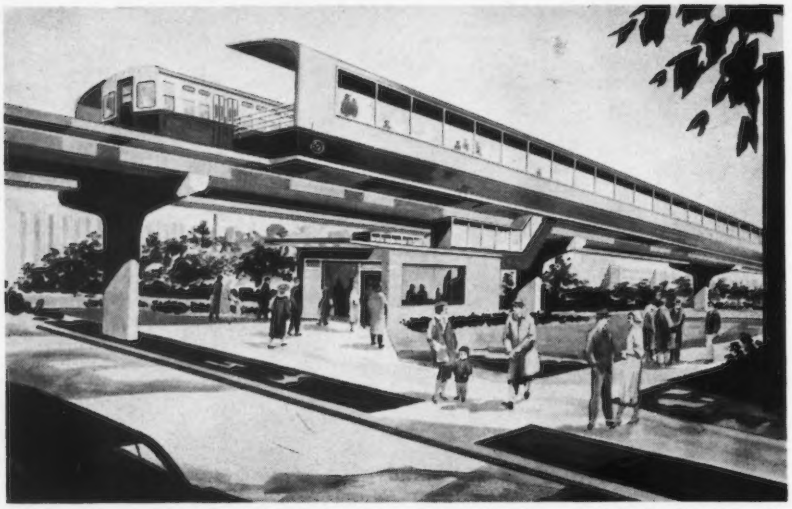
The major part of the existing rapid transit system, on which construction was started in 1892, was completed as long ago as 1910. Since 1938 three subways have been added—first the State Street subway, then the Milwaukee-Dearborn-Congress subway, and now the West Side subway extension —by the city of Chicago and cooperating public agencies at a cost of approximately $102,000,000. This is an average annual expenditure of only $5,000,000 when expenditures for rapid transit improvements and extensions should be at least $15,000,000 a year for the next 20 years.

Only 163 Miles of Rapid Transit Track

For the whole of Chicago and the 28 suburbs that are now served in



Cut-away section of the intersection of State and Washington streets shows the proposed Washington street bus subway crossing above the low-level State street subway. The bus subway would extend from Canal street to Michigan avenue, across the Central Business District. Estimated cost, $15,000,000.



Between its terminal at Kimball and Lawrence avenues and just west of Rockwell avenue, the Ravenswood route operates at street-level. View shows the proposed elevation on a single column, ballasted deck, and a typical station and platforms. With this elevation, a new bridge over the north branch of the Chicago River is to be constructed. Estimated cost, $4,750,000; terminal modernization, not including a large Park 'N' Ride garage, estimated cost, $350,000.

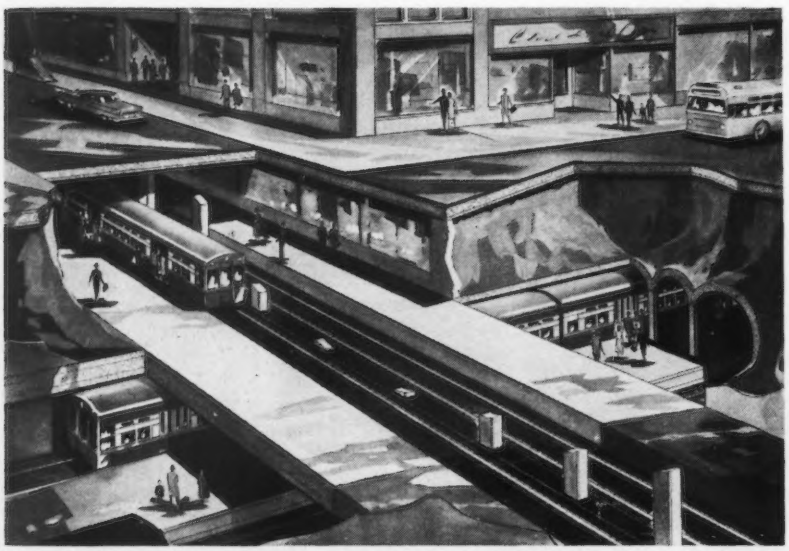
varying degree by the Chicago Transit Authority, there are only 163 miles of rapid transit revenue track, and more than 10 per cent of this total is at street grade. New York, which is little more than twice the size of Chicago in population, has more than four times as many miles of rapid transit revenue track.

The reason for New York's tremendous advantage over Chicago in rapid transit facilities is perfectly clear. New York has provided $2,800,000,000 in public funds — and is continuing to provide public funds at the rate of about $100,000,000 annually—for the expansion and improvement of its rapid transit facilities, including the purchase of rolling stock. New York transit riders' fares finance only the day-to-day operating costs of the service.

Transit's Financial Problems

In contrast to New York, Chicago placed its reliance completely upon private enterprise to provide and operate both its surface and rapid transit systems.

For a period the operations were profitable, particularly the surface lines system. New routes were established, and existing routes were extended, to keep pace with the increasing population and the expanding economic activities of the city and its suburbs.



View is looking southeast showing the proposed Jackson Boulevard subway passing over the State Street subway, and illustrating the center island platforms at State street and the proposed side platforms on the Jackson Boulevard subway.

By the late 1920's, however, the two major local transit companies, the Chicago Surface Lines and the Chicago Rapid Transit Company, were in serious financial difficulties as a result of the advent of intense competition from the private automobile. Both service and equipment were deteriorating rapidly.

At least five separate attempts were made to reorganize and refinance the two companies, either separately or as a single new company, but private investors could not be persuaded to invest any more money in local transit.

The situation reached the acutely critical stage by 1945. The Chicago Rapid Transit Company, much the weaker of the two companies financially, was struggling to meet operating payrolls, and was faced with the inevitable necessity of terminating its operations. To avoid this crisis, the state legislature in 1945 created the Chicago Transit Authority, a self-supporting, self-regulating public corporation to purchase and operate the city's major transit systems.

On October 1, 1947, Chicago Transit Authority bought the Chicago Surface Lines and the Chicago Rapid Transit Company, financing the purchase by the issuance and sale of revenue bonds to private investors. Five years later, on October 1, 1952, Chicago Transit Authority acquired the Chicago Motor Coach Company, the city's remaining major privately owned transit company.

Private Transit Losses Totaled $250 Million

With the sale of the Chicago Surface Lines and the Chicago Rapid Transit Company to Chicago Transit Authority, private investors in these two companies suffered losses totaling an estimated $250,000,000. Thus, in effect, the investors subsidized Chicago transit to the extent of a quarter of a billion dollars.

In the years that have followed since investors in Chicago transit gave up the struggle and took their huge losses, private investors in transit in many other cities, particularly smaller communities, have also abandoned the uneven struggle. Many of these cities are now totally without transit service. Elsewhere, privately-owned companies are receiving public financial aid, either directly or indirectly, to keep transit service going.

(Continued on page 54)

The Problem of The Amber Signal Light In Traffic Flow

By Denos Gazis, Robert Herman, and Alexei Maradudin*

Research Laboratories, General Motors Corporation, Warren, Michigan

A theoretical analysis and observations of the behavior of motorists confronted by an amber signal light are presented. A discussion is given of the following problem: when confronted with an improperly timed amber light phase a motorist may find himself, at the moment the amber phase commences, in the predicament of being too close to the intersection to stop safely or comfortably and yet too far from it to pass completely through the intersection before the red signal commences. The influence on this problem of the speed of approach to the intersection is analyzed. Criteria are presented for the design of amber signal light phases through whose use such 'dilemma zones' can be avoided, in the interest of over-all safety at intersections.

WE LIVE in a difficult and increasingly complex world where man-made systems, man-made laws and human behavior are not always compatible. This paper deals with a problem peculiar to our present civilization, for which a satisfactory solution based on existing information and analysis is not available. The problem in question is that of the amber signal light in traffic flow.

Undoubtedly everyone has observed at some time or other the occurrence of a driver crossing an intersection partly during the red phase of the signal cycle. There are few of us who have not frequently been faced with such a decision-making situation when the amber signal light first appears, namely, whether to stop too quickly (and perhaps come to rest partly within the intersection) or to chance going through the intersection, possibly during the red light phase. In view of this situation we were led to consider the following problem: can criteria presently employed in setting the duration of the amber signal light at intersections lead to a situation wherein a motorist driving along a road within the legal speed limit finds himself, when the green signal turns to amber, in the predicament of being too close to the intersection to stop safely and comfortably and yet too far from it to pass through, before the signal changes to red, without exceeding the speed limit? From experience we feel that a problem exists, and we ask if it is feasible to construct a signal light system such that the characteristics of a driver and his car, the geometry of the road and intersection, and the law are all compatible with one another.

Some thought has already been devoted to this question[1,2] but it is our opinion that the problem at hand does not appear to have been thought through deeply enough as a problem in operations research nor does it appear to have been supported adequately by published observational and experimental data. It is our intention in this paper to contribute toward the understanding of this situation. First, we derive and discuss some simple relations between car speed, driver decision and reaction time, the parameters of the road and intersection, and the duration of the amber signal light. The results of measurements of the duration of amber signal lights, driver decision plus reaction time, and other parameters entering into the theoretical discussion are next presented. Finally, we discuss the experimental results in the light of theory and the traffic codes of cities and towns throughout the country.

We are well aware that there may be practical difficulties involved in incorporating the results and conclusions of an analysis such as ours into the practical planning of traffic systems, and we do not consider such problems here. It is our hope, rather, that in pointing out the existence and nature of the amber-signal-light problem we may stimulate others to pursue it further and make certain that the driver is confronted with a solvable decision problem. We are, of course, also motivated by the desire to contribute effectively toward the improvement of over-all driver safety and, in this case specifically, safety at intersections.

Analytical Considerations

We consider the traffic situation depicted in Figure 1, in which a car traveling at a constant speed v_0 toward an intersection is at a distance x from the intersection when the amber phase commences. The driver is then faced with two alternatives. He must either decelerate and bring his car to a stop before entering the intersection or go through the intersection, accelerating if necessary, and complete his crossing before the signal turns red. In these cases his acceleration or deceleration will begin at a time δ_1 or δ_2 after the initiation of the amber phase, respectively. These time intervals δ_i measure the reaction time-lag of the driver-car complex as well as the decision-making time of the driver.

In order to carry out a mathematical investigation of the problem we assume a constant deceleration a_1 in the case of crossing the intersection, or a constant deceleration

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*Permanent address of Dr. Maradudin: Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Md.

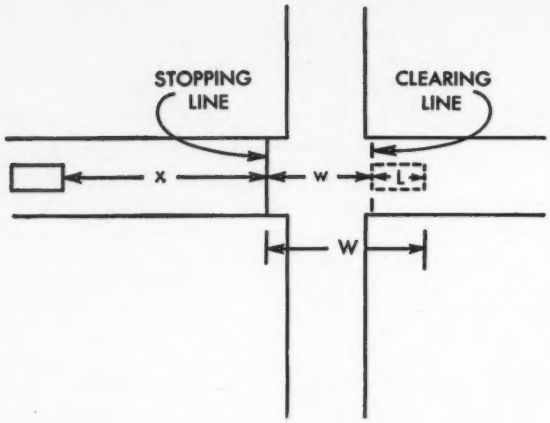


Figure 1

Geometry of an intersection showing distances to be covered by a car of length L in the two alternative cases of going through and stopping before the intersection.

a_2 in the case of stopping before entering the intersection. If, furthermore, the effective width of the intersection is denoted by w, the length of the car by L and the duration of the amber phase by τ, the following relations can be derived:

1. If the driver is to come to a complete stop before entering the intersection, we find that

$$(x-v_0\,\delta_2)\geqq v_0^2/2a_2. \qquad (1)$$

2. If the driver is to clear the intersection completely before the light turns red, we must have

$$(x+w+L-v_0\,\delta_1)\leqq v_0\ (\tau-\delta_1)+\tfrac{1}{2}\,a_1\,(\tau-\delta_1)^2. \quad (2)$$

It is to be noted that the effective width, w, used in the preceding equation is meant to denote the approximate distance between a painted stopping line or a building line and a 'clearing line' whose position is necessarily somewhat indefinite because of the geometry of real intersections.

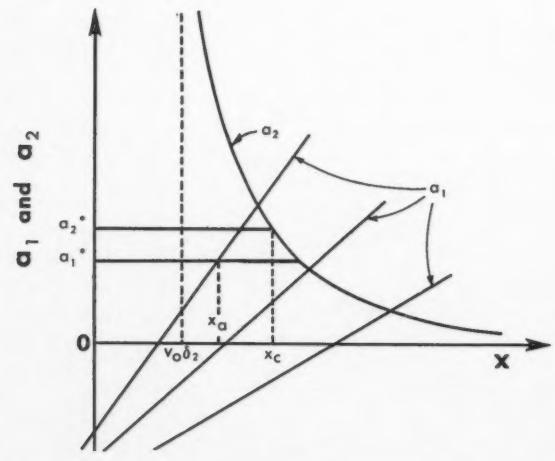


Figure 2

Variation of the deceleration required in order to stop before the intersection, a_2, or the acceleration required to clear the intersection, a_1, versus the distance from the intersection, x. The x-intercept of the a_1 versus x lines defines a distance x_0 which is the maximum distance, apart from the width of the intersection and the length of car, which can be covered without acceleration during the amber phase.

Equations (1) and (2) can be used for the discussion of the two alternatives and their ramifications. Thus, solving equation (1) for a_2 we obtain, assuming the equality sign,

$$a_2=\tfrac{1}{2}v_0^2/(x-v_0\,\delta_2). \qquad (3)$$

Equation (3) gives the (constant) deceleration needed in order to bring the car to a stop just before the intersection as a function of the distance of the car from the intersection at the initiation of the amber phase. We see that a_2 becomes infinite for $x=v_0\,\delta_2$, as it must. However, even for values of x greater than $v_0\,\delta_2$, the deceleration given by (3), while finite, may be so large as to be uncomfortable to the driver and his passengers, or may be unsafe under the prevailing road conditions, or even physically impossible. Therefore, assuming the existence of a maximum deceleration a_2^* by which the car can be brought to a stop before the intersection safely and comfortably, equation (1) defines a 'critical distance', namely,

$$x_c=v_0\,\delta_2+v_0^2/2a_2^*. \qquad (4)$$

If $x>x_c$ the car can be stopped before the intersection, but if $x<x_c$ it will be uncomfortable, unsafe, or impossible to stop. We note that this critical distance is independent of the duration of the amber phase, τ, and depends only on the characteristics of the driver-car complex. The required deceleration is plotted versus distance in Fig. 2.

Turning now, to the second alternative, namely, going through the intersection, we solve equation (2) for a_1, assuming the equality sign, and obtain

$$a_1=2\ x/(\tau-\delta_1)^2+2(w+L-v_0\ \tau)/(\tau-\delta_1)^2. \quad (5)$$

Equation (5) gives the (constant) acceleration needed in order that the car may clear the intersection just as the signal turns red, as a function of the distance x of the car from the intersection at the start of the amber phase. For various values of the parameters involved, equation (5) represents a family of straight lines in the x,a_1-plane with slope

$$da_1/dx=2/(\tau-\delta_1)^2, \qquad (6)$$

and intercept on the x-axis,

$$x_0=v_0\tau-(w+L). \qquad (7)$$

The quantity x_0 is the maximum distance the car can be from the intersection at the start of the amber phase and still clear the intersection without acceleration during the amber phase. The position of x_0 with respect to x_c, and the character of the line represented by equation (5), determine whether or not the duration of the amber phase has been adequately designed, taking into account the requirements of the law and the physical 'boundary conditions' of the problem. Thus, if $x_0>x_c$, the driver, once past the critical distance x_c, can clear the intersection before the signal turns red. If, however, $x_0<x_c$, a driver at a distance x from the intersection such that $x_0<x<x_c$ will find himself in a very awkward position if the amber phase begins at that moment. He cannot stop safely and hence he has to attempt to go through the intersection. From Fig. 2 we see that he can achieve this only by accelerating. If, however, v_0 happens to be the maximum allowable speed, the driver will find himself in the following predicament. He can neither bring his car to a stop safely nor can he go through

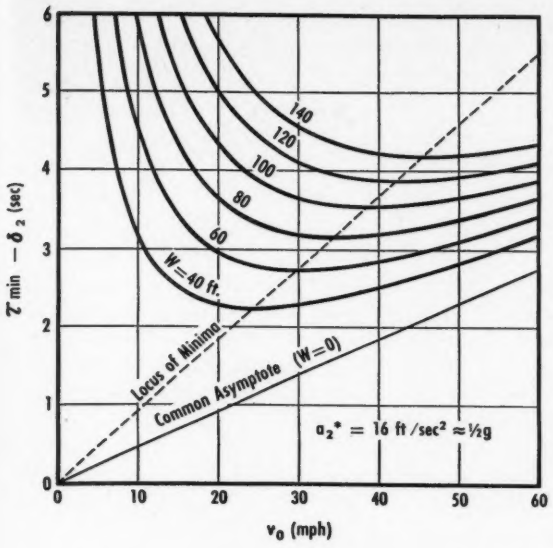


Figure 3

Variation of the minimum amber-phase duration, τ_{min}, which is required in order that there be no dilemma zone, versus constant approach speed, v_0, for various intersection widths plus car length, W. (The constant deceleration is assumed to be 16 ft/sec^2.)

the intersection before the signal turns red without violating the speed limit.

There is an even worse possibility, which is realized for even shorter values of τ. This is the case where $x_0 < x_c$ and the slope da_1/dx is sufficiently large that the line represented by equation (5) intersects a line $a_1 = a_1^*$, where a_1^* is a maximum possible acceleration, at a point which has an abscissa x_a smaller than x_c. Then, for $x_a < x < x_c$, a driver cannot stop safely and he cannot clear the intersection before the initiation of the red light phase even if he is willing to utilize all the power resources of his car while violating the speed limit.

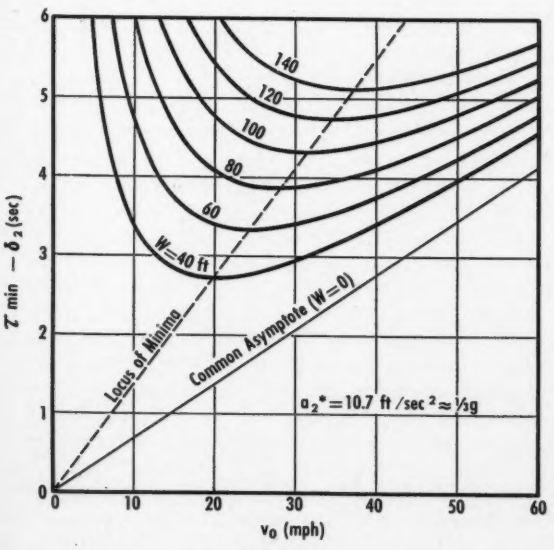


Figure 4

Variation of the minimum amber-phase duration, τ_{min}, which is required in order that there be no dilemma zone, versus constant approach speed, v_0, for various intersection widths plus car length W. The constant deceleration is assumed to be 16 ft/sec^2.)

TABLE I

COMPARISON OF OBSERVED AND CALCULATED AMBER-PHASE DURATIONS

Street	Cross street	Speed limit (mi/hr)	Approximate effective width of intersection	Duration of amber phase	Theoretical τ_{min}: eq. (5)[a]			
					$a_2^* = 10.7$ ft/sec^2		$a_2^* = 16$ ft/sec^2	
					$\delta_2 =$ 1.14 sec	$\delta_2 =$ 0.75 sec	$\delta_2 =$ 1.14 sec	$\delta_2 =$ 0.75 sec
South of Main	Catalpa	25	60	2.7[b]	4.91	4.52	4.33	3.94
North on Mound	Chicago	30	75	3.4	5.25	4.86	4.56	4.17
East on Chicago	Van Dyke	30	80	4.0	5.36	4.97	4.67	4.28
North on Woodward	Calvert	30	—	3.6	—	—	—	—
East on 11 Mile	Van Dyke	35	55	3.4	4.90	4.51	4.10	3.71
West on 14 Mile	Southfield	35	60	6.8	5.00	4.61	4.20	3.81
South on Woodward	9 Mile	35	80 to 120	4.5	5.39 6.16	5.00 5.77	4.59 5.36	4.20 4.97
North on Woodward	Savannah	35	65	3.85	5.10	4.71	4.30	3.91
North on Mound	13 Mile	40	50	3.6	5.00	4.61	4.09	3.70
West on Chicago	Van Dyke	40	80	4.0	5.51	5.12	4.60	4.21
West on 8 Mile	Ryan	40	70	3.9	5.34	4.95	4.43	4.04
North on Van Dyke	12 Mile	40	80	4.1	5.51	5.12	4.60	4.21
East on 12 Mile	Van Dyke	45	65	4.0	5.44	5.05	4.41	4.02
North on Woodward	11 Mile	45	80	3.44	5.67	5.28	4.64	4.25
North on Woodward	Lincoln	45	75	3.75	5.59	5.20	4.56	4.17
South on Van Dyke	Chicago	50	70	3.8	5.74	5.35	4.60	4.21

[a] Two values of the time lag δ_2 were assumed. One of them is the observed average 1.14 sec and the other a lag of 0.75 sec frequency assumed as a minimum. A car length was taken as 15 ft to be conservative. Two values for the maximum deceleration a_2^* were assumed. One of them is equal to $\frac{1}{2}g$ which is feasible but is a fairly high deceleration not desirable in normal driving. The other one is equal to $\frac{1}{3}g$, which corresponds to a very hard stop. (Note that 0.6 g is about the absolute maximum deceleration under ideal conditions.)

[b] The amber phase here was measured at about 2.1 sec prior to a modification in the signal cycle. We have been informed of an even shorter amber phase of only about 1.5-sec duration at an intersection in California where an individual received a ticket for being in this intersection on the red signal.

It may be pointed out that this maximum possible acceleration depends on the approach velocity v_0. It is well known that the higher the velocity of a car the lower its accelerating capability. Thus an average good car can have an acceleration of as much as $\frac{1}{2}$ g starting from rest, but only about 0.08 g when traveling at 65 mi/hr.† (Note that g is the earth's gravitational acceleration.)

Let us now discuss the design of the duration of the amber phase. From the graphical representation of Fig. 2, we see that the minimum amber-light duration, denoted by τ_{min}, which guarantees the safe execution of either one of the alternatives of stopping or going through the intersection without accelerating, corersponds to $x_0 = x_c$. Hence

$$\tau_{min} = (x_c + w + L)/v_0, \tag{8}$$

and, using equation (4),

$$\tau_{min} = \delta_2 + \tfrac{1}{2}\, v_0/a_2^* + (w+L)/v_0. \tag{9}$$

A simple numerical example will show the magnitude of the quantities involved. Assuming $v_0 = 45$ mi/hr $= 66$ ft/sec, $a_2^* = 0.5\ g \approx 16$ ft/sec^2, $\delta_2 = 1$ sec, $w = 65$ ft, and $L = 15$ ft, we find $x_c = 202$ ft and $\tau_{min} = 4.28$ sec.

It may be noted that the length of the car, L, is added to the effective width of the intersection, w, in order to determine the length of travel through the intersection. The length of the car contributes the quantity L/v_0 in the computation of τ_{min}. This means that the required τ_{min} is substantially longer for vehicles such as long trucks, buses, or vehicles with trailers, even assuming that these vehicles

†We are indebted to Mr. Joseph Bidwell for furnishing us with the experimental data on the accelerating capability of a car as a function of its speed.

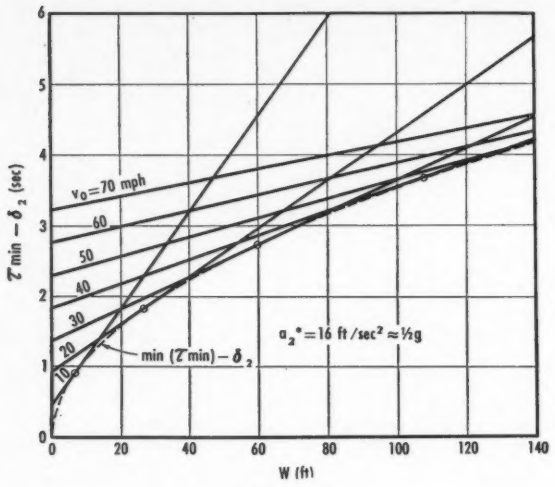


Figure 5

Variation of the minimum amber-phase duration, τ_{min}, which is required in order that there be no dilemma zone, versus the intersection width plus car length, W, for various values of the constant approach speed, v_0. (The constant deceleration is assumed to be 16 ft/sec^2.)

can stop with the same maximum deceleration a_2* as shorter ones. One may retort that traffic signals should not be designed for these 'unusual' cases. However, these unusual vehicles *are* allowed on the highways, and if the design of the amber phase does not take them into account then the questions raised in the introduction regarding the compatibility of law and physical characteristics become even more acute.

Returning now to the expression for τ_{min} given in equation (9), we use this result to plot τ_{min} versus v_0 in Figures 3 and 4 for various values of the parameter

$$W = w + L \tag{10}$$

and for two values of the maximum deceleration a_2*, namely, ½ g and ⅓ g. (For comments on the magnitude of these decelerations, see the first footnote in Table I, as well as reference 2, p. 68.) The minima of the various

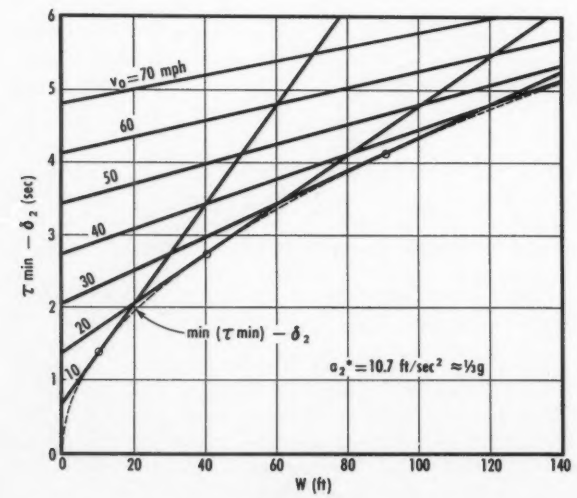


Figure 6

Variation of the minimum amber-phase duration, τ_{min}, which is required in order that there be no dilemma zone, versus the intersection width plus car length, W, for various values of the constant approach speed, v_0. (The constant deceleration is assumed to be 10.7 ft/sec.)

curves correspond to values of the approach velocity v_0, assumed equal to the speed limit, which would minimize τ_{min} for a given value of W. From equation (9) we have

$$\partial\tau_{min}/\partial v_0 = 1/2a_2^* - W/v_0^2, \tag{11}$$

and $\partial\tau_{min}/\partial v_0 = 0$ for $\quad v_0 = \sqrt{2\,a_2^*\,W}$. (12)

Hence the absolute minimum length of the amber phase is given by

$$\min(\tau_{min}) = \delta_2 + \sqrt{2\,W/a_2^*}. \tag{13}$$

Figures 5 and 6 contain plots of $(\tau_{min} - \delta_2)$ versus W for different values of the approach velocity v_0, and for the same two values of a_2* as in Figs. 3 and 4. Equation (9) yields a family of straight lines in the plane $(\tau_{min} - \delta_2)$ versus W. The envelope of these lines corresponds to $\min(\tau_{min})$ as given by equation (13).

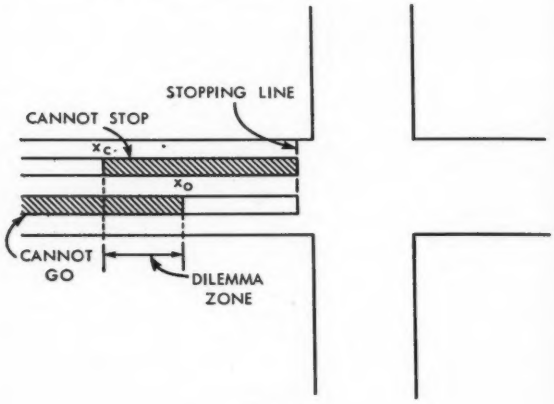


Figure 7

Schematic diagram showing the 'dilemma zone' near an intersection.

The foregoing discussion is illustrated in Figure 7, where each of the two shaded zones precludes one of the two alternatives of stopping or going through the intersection. Thus, a car at a distance from the intersection smaller than x_c cannot stop safely, whereas a car at a distance greater than x_0 cannot go through the intersection without accelerating before the light turns red.

As mentioned already, when $x_0 < x_c$ the driver is in trouble if he finds himself in the region $x_0 < x < x_c$, which in the sequel will be referred to as the 'dilemma zone.'

The preceding arguments have been established on the assumption that the approach speed of the motorist is equal to the speed limit so that he cannot accelerate to clear the intersection without exceeding the speed limit. It is possible, however, that even if the amber phase is improperly set so that a dilemma zone exists for an approach speed equal to the speed limit, a motorist may, under certain circumstances, avoid encountering such a dilemma zone if his approach speed is smaller than the speed limit. This is so because the critical distance, x_c, decreases rapidly as the approach speed decreases. On the other hand, if the driver is at a distance from the intersection slightly larger than this reduced x_c when the amber-light phase begins he may be able, under certain circumstances, to clear the intersection within this phase by accelerating until he has reached the speed limit and then proceeding through the intersection at this speed. An example of this case is illustrated in Figure 10, which is discussed a little later.

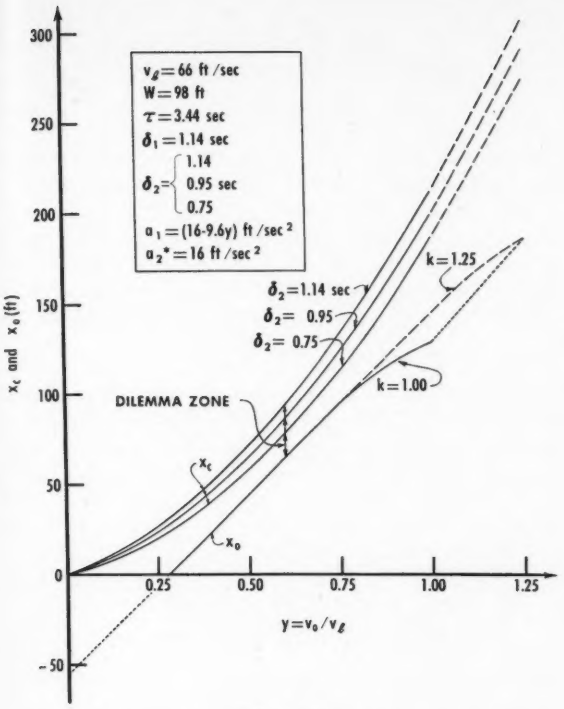


Figure 8

Northbound on Woodward Avenue at 11 Mile Road. Variation of the critical distance, x_c, and the maximum distance which can be covered within the amber phase duration, x_0, versus the ratio of the approach speed to the speed limit, $y=v_0/v_l$. It is assumed that in crossing the intersection the car may accelerate up to a speed not in excess of kv_l.

If we assume that the driver's acceleration from v_0 to v_l (the speed limit) is constant and equal to a_1, the equation which replaces equation (2) is

$$x_0=\begin{cases} v_0\,\delta_1-W+(v_l^2-v_0^2)/2a_1+v_l[\tau-\delta_1-(v_l-v_0)/a_1] \\ \qquad\qquad \text{for} \quad \tau\geqq\delta_1+(v_l-v_0)/a_1, \\ v_0\,\delta_1-W+v_0(\tau-\delta_1)+(\tfrac{1}{2}a_1)\quad(\tau-\delta_1)^2 \\ \qquad\qquad \text{for} \quad \tau\leqq\delta_1+(v_l-v_0)/a_1, \end{cases} \tag{14}$$

where W is given by (10) and x_0 is the distance of the car from the intersection at the moment the amber phase commences. It is assumed that the car just clears the intersection before the light turns red. Rewriting (14) to give x_0 as a function of $y=v_0/v_l$, where $0\leqq y\leqq 1$, we obtain

$$x_0=\begin{cases} -W+v_l\,\tau-v_l\,\delta_1\,(1-y)-(v_l^2/2a_1)\,(1-y)^2 \\ \qquad\qquad \text{for} \quad \tau\geqq\delta_1-(v_l/\alpha_1)(1-y), \\ -W+\tfrac{1}{2}\,a_1(\tau-\delta_1)^2+v_l\,\tau y \\ \qquad\qquad \text{for} \quad \tau\leqq\delta_1-(v_l/a_1)(1-y). \end{cases} \tag{15}$$

Equation (1) remains unchanged, so that

$$x_c=\delta_2\;v_l\;y+(v_l^2/2a_2^*)\;y^2. \tag{16}$$

For simplicity we assume that $\delta_1=\delta_2=$ 1.14 sec (*see* the following section), while $a_2^*=\frac{1}{2}\,g=16$ ft/sec². The (constant) acceleration a_1 is, however, a function of the car speed at the moment when the car begins to accelerate. An analytic expression for this speed dependence of a_1, which fits the experimental data adequately enough for our purposes is

$$a_1(v_0)=\begin{cases} (16-0.145\,v_0)\ \text{ft/sec}^2 & \text{for} \quad 0\leqq v_0\leqq 110\ \text{ft/sec}, \\ 0 & \text{for} \quad v_0 \quad >110\ \text{ft/sec}, \end{cases} \tag{17}$$

where v_0 is given in ft/sec. We assume, for simplicity, that a car traveling at an approach speed v_0 can maintain a constant acceleration a_1, as given by equation (17), for a length of time of the order of τ. It should be noted that there are marked differences in the dynamic characteristics of various cars with regard to acceleration. The preceding equation gives an acceleration which is on the high side and is applicable to the high-powered modern car. Low-powered cars develop considerably lower accelerations, particularly at high speeds. If one were to assume lower accelerations, the problem of the dilemma zone would be accentuated.

Using equations (15), (16), and (17), we have plotted x_0 and x_c as functions of y for three different intersections in Figs. 8, 9, and 10.

The curve for x_0 has a straight segment, corresponding to the second expression in (15), and a curved segment corresponding to the first expression. These two segments are tangent at the point y_t satisfying the equation

$$1-y_t-(\tau-\delta_1)\,(a_1/v_l)=0. \tag{18}$$

Hence, in view of (17), we have

$$y_t=[1-16\;(\tau-\delta_1)/v_l]/[1-0.145\;(\tau-\delta_1)\,], \tag{19}$$

where speeds are given in ft/sec and times in seconds.

From Figure 7 we see that there is no dilemma zone if $x_0>x_c$; of the situations depicted in Figures 8–10 we see that in only one case, namely, that shown in Figure 10, is there an absence of a dilemma zone, and this is so only for $0.15<y<0.57$. This means that at this particular intersection a car traveling at the speed limit of 65 mi/hr would encounter a dilemma zone of 106 ft, approximately six

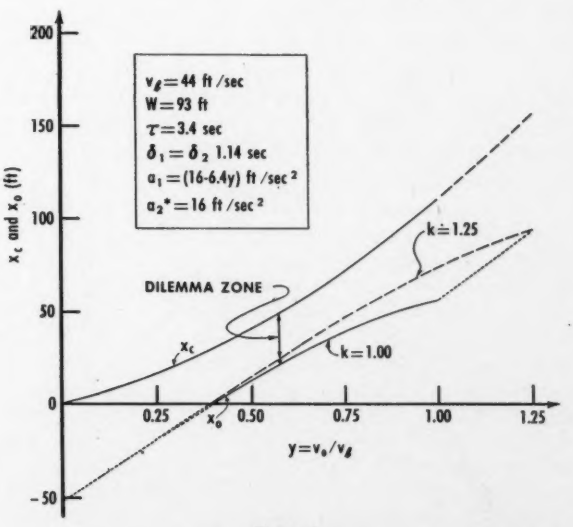


Figure 9

Northbound on Mound Road at Chicago Road. Variation of the critical distance, x_c, and the maximum distance which can be covered within the amber phase duration, x_0, versus the ratio of the approach speed to the speed limit, $y=v_0/v_l$. It is assumed that in crossing the intersection the car may accelerate up to a speed not in excess of kv_l.

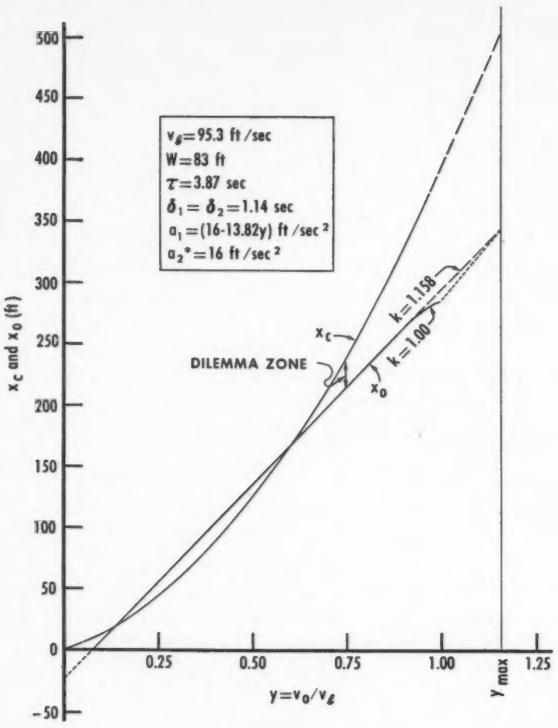


Figure 10

Northbound on Stephenson Highway at 15 Mile Road. Variation of the critical distance, x_c, and the maximum distance which can be covered within the amber phase duration, x_0, versus the ratio of the approach speed to the speed limit, $y=v_0/v_l$. It is assumed that in crossing the intersection the car may accelerate up to a speed not in excess of kv_l. The value of $k=1.157$ corresponds to the maximum speed of 110 ft/sec according to equation (17).

car-lengths, at a distance of 286 ft from the intersection. On the other hand, if the speed of the car is 37 mi/hr or lower, no such zone exists. It need hardly be pointed out that under ordinary driving conditions a speed of 37 mi/hr on a highway with a 65 mi/hr-maximum is unrealistic, and quite possibly dangerous.

From the preceding discussion we ascertain that if one were to assume, for low-powered cars, accelerations lower than those given by (17), the values of x_0 would be reduced considerably and the dilemma zones increased in the entire range $0 \leqq y \leqq 1$.

Approaching an intersection at a speed lower than the speed limit is one facet of defensive driving. It is seen from the preceding discussion that this in itself is not always sufficient to obviate the dilemma-zone problem. Another facet of such defensive driving consists of the maneuver of coasting toward the signal light with one's foot readied on the brake. The advantage, in this case, which comes from shortening the reaction time, is reflected in a decrease of the critical distance x_c. The improvement, which is by no means an absolute cure, can be seen from the curves plotted in Fig. 8 for two values of δ_2 other than the observed average. Such defensive driving, however, should be used with discrimination and great caution when approaching intersections in a high-density traffic pattern since it may induce a rear-end collision—a prominent type of accident in traffic today.

Many drivers take the attitude that there is nothing sacred about the speed limit! Suppose one, starting with an initial speed $v_o=yv_l$, where v_l is again the official speed limit, accelerates to a final speed equal to or less than v_l' given by

$$v_l'=kv_l. \qquad (k>1) \qquad (20)$$

The analysis already carried out can be applied to this case on the assumption that the 'effective speed limit' is $v_l'=kv_l$ and the initial speed

$$v_o=y'v'=(y/k)\ v_l'. \qquad (0 \leqq y' \leqq 1) \qquad (21)$$

The x_c versus y curve obviously does not change. The ordinate of the x_0 versus y curve at $y'=1$, i.e., at $y=k$, is

$$x_0{}^*=-W+v_l\ \tau k. \qquad (22)$$

In Figures 8 and 9 we have plotted with dashed lines the curves of x_0 corresponding to 'effective speed limits' equal to 1.25 v_l (i.e., $k=1.25$). Similarly in Figure 10 we have plotted with a dashed line the curve of x_0 for $k=1.158$. This value of k corresponds to an 'effective speed limit' equal to the assumed maximum possible speed of 110 ft/sec (75 mi/hr), according to equations (17). Again, these curves are made up of two segments, one straight and one curved, which are tangent at the point

$$y_t'=[k-16\ (\tau-\delta_1)/v_l]/[1-0.145\ (\tau-\delta_1)]. \qquad (23)$$

The straight segment is an extension of the one already plotted on the basis of the second expression in (15), which is independent of the effective speed limit.

From these figures we see that even if the driver is willing to accelerate to speeds greatly in excess of the speed limit, he still cannot eliminate the dilemma zone.

With regard to the length of the dilemma zone, the following additional remark can be made on the basis of the preceding discussion. If a driver encounters a dilemma

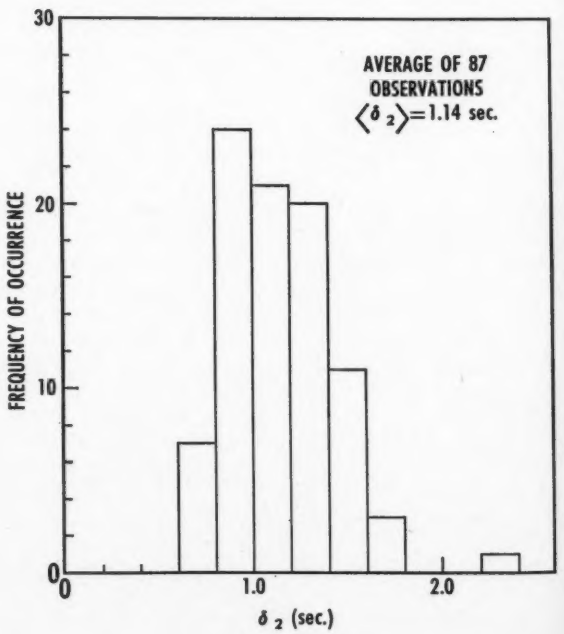


Figure 11

Histogram showing the observed frequency of occurrence of various intervals of decision and reaction time in braking, δ_2, in a total of 87 measurements.

zone, the maximum possible distance of the rear bumper of his car from the clearing line of Figure 1 at the moment the red phase commences is equal to the length of the dilemma zone. This maximum distance is realized if the driver is just past x_c when the amber phase commences. Now, if the indecision zone is greater than the effective width of the intersection plus the car length, W, the driver may even have to *enter* the intersection during the red phase. From Figure 10 it is seen that this may happen, at the intersection under consideration, to a driver who approaches the intersection at the speed limit and does not want to exceed this limit, since in this case the dilemma zone of 106 ft is greater than $W=83$ ft.

Observations

In order to compare the theoretical results of the preceding section with physical reality the following kinds of observations were carried out on the manner in which people actually drive and the pattern in which amber signal light phases are in practice set:

1. Duration of amber-light phase.
2. Motorists' braking reaction time (including the decision time and the reaction time lag).
3. Average number of motorists per cycle who run through the red light.
4. The dimensions of the road and intersection together with the posted speed limit.
5. Traffic density.
6. The effective critical distance x_c.

Most of the observations were made at street intersections within about a fifteen-mile radius of the General Motors Technical Center. It was not our intention to make our data exhaustive, but we feel that enough measurements were made so that fairly definite conclusions based on them could be drawn.

We begin by presenting in Table I a sampling of the data obtained on the amber-signal-light times, speed limits, and approximate intersection widths, at a number of intersections, together with theoretical values of the minimum amber-light phase, τ_{min}, calculated from equation (8) using two values of the maximum deceleration and two values of the braking reaction time.

In measuring the drivers' braking reaction time, an observer was stationed near a given intersection at a distance somewhat greater than the estimated x_c. The observer would then arbitrarily choose a car in the interval between himself and the intersection and would measure the time interval between the moment the amber signal came on and the moment when the red brake tail light flashed. The distribution of such delay times is plotted in Figure 11 on the basis of 87 observations. The mean delay time was found to be 1.14 seconds.

The determination of an average effective x_c was carried out using the following criterion: it is the closest distance at which a car can be from the intersection, when the amber signal commences, and still be capable of stopping before entering the intersection. Measurements of this quantity were made at several intersections and the results are shown in Table II together with the theoretical values calculated from equations (4). The observed x_c was in general a little smaller than the theoretical x_c corresponding to the speed limit of the observed intersections. This was probably due to the fact that the traffic was moving, on the average, a little slower than the posted speed limit, since our observations were made during the heavy traffic of the rush hour.

TABLE II

OBSERVED AND CALCULATED CRITICAL DISTANCE, x_c

Street	Cross street	Speed limit	Effective x_c	Theoretical x_c ($a_0^*=0.5$ g)
North on Woodward Avenue	Lincoln	45 mi/hr	165 ft	211 ft
West on 8 Mile Road	Ryan	40	145	174
North on Woodward Avenue	11 Mile Road	45	185	211

TABLE III

TRAFFIC FLOW AND PER CENT TRAFFIC-LIGHT VIOLATIONS

Street	Cross street	Number cars in intersection per cycle	Average number cars running through red signal per cycle	Per cent of cars running through red signal	Amber phase (sec)
North on Woodward Avenue	Lincoln	62.3	1.2	1.93	3.75
		53.8	0.8	1.49	3.73
West on 8 Mile Road	Ryan	42.1	0.7	1.66	3.9
North on Woodward Avenue	11 Mile Road	54.5	1.2	2.20	3.49
North on Woodward Avenue	Woodland	91.6	0.5	0.55	4.23
North on Woodward Avenue	Sylvan	95.1	0.1	0.11	4.69
North on Woodward Avenue	Webster	46.1	0.4	0.87	3.67

Finally, we measured at a few intersections the average number of cars that ran through the red signal per signal light cycle during rush hour traffic (4:30–6:00 p.m.), together with the average number of cars that pass through the intersection per signal light cycle. These results are shown in Table III.

The preceding pertains to a single traffic light. Analogous results may be obtained for two closely spaced traffic lights, as in the case of crossing of a divided highway. However, this case is rather complicated and will not be discussed here. There are other variations to the problem of the dilemma zone such as the case of a vehicle approaching an intersection at slow speed with the intention of making a turn. This is a case of known practical difficulty and some information can be obtained from the present analysis with w taken equal to the distance traversed while turning.

Some additional data regarding the amber-light phase were obtained from three other cities, namely, Washington, D.C., Silver Spring, Maryland, and Los Angeles, California. On the average, the amber-light phases were slightly shorter in Los Angeles and slightly longer in the Washington, D.C., area, relative to those in the Detroit area. There are no significant differences, and the conclusions of this paper will apply in those areas also.

Discussions and Conclusions

The Uniform Vehicle Code of the National Committee on Uniform Traffic Laws and Ordinances[3] gives the following definition for the purpose of the amber signal light:

> Vehicular traffic facing the signal is thereby warned that the red or 'Stop' signal will be exhibited immediately thereafter and such vehicular traffic shall not enter or be crossing the intersection when the red or 'Stop' signal is exhibited.

Most of the traffic ordinances throughout the United States that we have seen have followed this definition with slight variations such as the omission of the phrase "or be crossing (the intersection). . . ." Some ordinances make an attempt to provide an operational definition of the meaning of the amber signal with definite instructions to

the driver on how to behave. A typical example of such an ordinance is the following:

> Vehicular traffic facing the signal shall stop before entering the nearest crosswalk at the intersection, but if such stop cannot be made in safety, a vehicle may be driven cautiously through the intersection.

Both definitions, of course, assume that the signal has been designed properly so that the driver can behave as directed and in general can solve the decision problems he encounters. It is interesting to note that the Manual on Uniform Traffic Control Devices for Streets and Highways[4] makes the following statement:

> Confusion has frequently arisen from the misuse of this yellow lens. When the length of yellow vehicle-clearance interval is correct, and the standard meaning above described† is generally observed, necessary functions of warning and clearing the intersection are performed by this interval.

This is a reasonable statement to which we, of course, subscribe. Our investigations show, however, that out of approximately 70 intersections studied, only one had an amber phase long enough to prevent an appreciable dilemma zone, i.e., a zone longer than about one car-length, if one assumes a 'comfortable' deceleration of $\frac{1}{3}$ g and a decision and reaction time-lag equal to our measured average of 1.14 sec. Even if one assumes the very large deceleration of $\frac{1}{2}$ g and a decision-reaction time lag of 0.75 sec, only four out of the 16 typical intersections of Table I yield a dilemma zone smaller than one car-length. Out of these four, one, namely the sixth one in Table I, gives no dilemma zone at all and is the only such intersection observed in the area.

The fact that almost all the intersections have sizeable dilemma zones is reflected in the data of Table III, which indicate that at the intersections studied as many as two cars went through the red light per light cycle, with an average of close to one car per cycle. It is true that in none of the observed cases did there appear to be any distinct possibility of an accident. However, the fact remains that an average of eleven out of every thousand cars were very much in the middle of the intersection when the red signal started, in violation of the Uniform Vehicle Code. This leaves them open to the possibility of receiving a traffic citation from an assiduous police officer. We might mention here that we were rather surprised to discover a traffic ordinance that made no distinction whatsoever between the yellow and red lights. The instruction regarding both was that "Vehicular traffic facing the signal shall stop before entering the nearest crosswalk at the intersection," a requirement which is clearly impossible to obey under many circumstances. It is interesting to note that in a state-issued driver-instruction pamphlet we again find that the amber and red lights are interpreted alike without regard to the operational problems considered here. The same pamphlet instructs drivers to ". . . drive a reasonable speed which will allow me to stop when the amber light comes on." The analysis given in this paper clearly shows that even reduction of speed and defensive driving when approaching an intersection does not necessarily eliminate the dilemma zone problem if the amber phase is inadequate.

The problem of determining the proper duration of the amber phase of the light cycle is perhaps more difficult and complicated than may appear at first sight. In this connection we quote Matson, Smith, and Hurd:[1] "In urban areas where speeds are relatively low, yellow lights of about 3-sec duration are satisfactory at most locations. At rural, high-speed locations where stopping time may have a duration of 5 to 8 sec, road users tend to attempt to clear the intersection rather than stop. Five seconds is probably a practical maximum yellow duration in such location."

We are aware of the fact that traffic engineers are inclined to shorten the amber phase for various reasons. One of them, probably one of the most important ones, is their conviction, undoubtedly substantiated, that drivers are inclined to ignore a long amber phase and treat it as merely a continuation of the green phase. They believe that as many drivers, if not more, will go through the red light when the amber phase is too long, as will do so if it is too short. However, we believe that it is the duty of the traffic engineers and the drafters of traffic ordinances to present the average, honest, driver with a solvable decision problem. As it stands now, a driver who is in the middle of an intersection when the red light comes on may not be a deliberate violator, but may be the victim of an improperly designed light cycle. It is true that accidents are in general prevented because of some delay of approach of the cross traffic and also by the judicious use of overlapping red cycles. This fact, however, does not release the unwilling violator from the legal responsibility which may become alarming in the case of an accident. On the other hand, with an adequate amber phase it would be easier to separate the violators from the nonviolators, insofar as traffic is concerned.

We believe that a correct resolution of this problem may be found in one of the following alternatives:

1. Design the amber-light phase according to some realistic criteria in order to guarantee that a driver can always be in a position to obey the law.
2. If the amber-light phases are to be kept short relative to criteria such as determined herein, it may be desirable to state the vehicle code in such a way as to make it compatible with the driver, car, road, and signal characteristics.

In either case it would be very advisable to educate both the driving public and the law-enforcing agencies as to the exact operational definition of the amber light. Needless to say, the fewer the variations of traffic ordinances in this respect, from one locality to another, the fewer the chances of confusion. We wish to re-emphasize our hope that a well-thought-out and operationally sound traffic and enforcement system, together with the healthy driver attitudes of a properly educated public, will promote safer and more efficient driving conditions.

Acknowledgments

We wish to thank Dr. D. L. Gerlough, Ramo-Wooldridge; Mr. R. Morison, Applied Physics Laboratory, The Johns Hopkins University; and Messrs. J. B. Bidwell, N. D. Crane, and R. A. Richardson, of this laboratory; for some valuable discussions and comments regarding this paper.

(Continued on page 53)

†The standard meaning referred to is precisely that quoted above as due to the Uniform Vehicle Code of the National Committee on Uniform Traffic Laws and Ordinances.[4]

Traffic Assignment to Street And Freeway Systems

By William L. Mertz
Highway Engineer
Division of Development, Office of Operations
Bureau of Public Roads

This is the second in a series of articles on computers, the coordinator of the series being D. L. Gerlough. The third article will appear in an early issue.

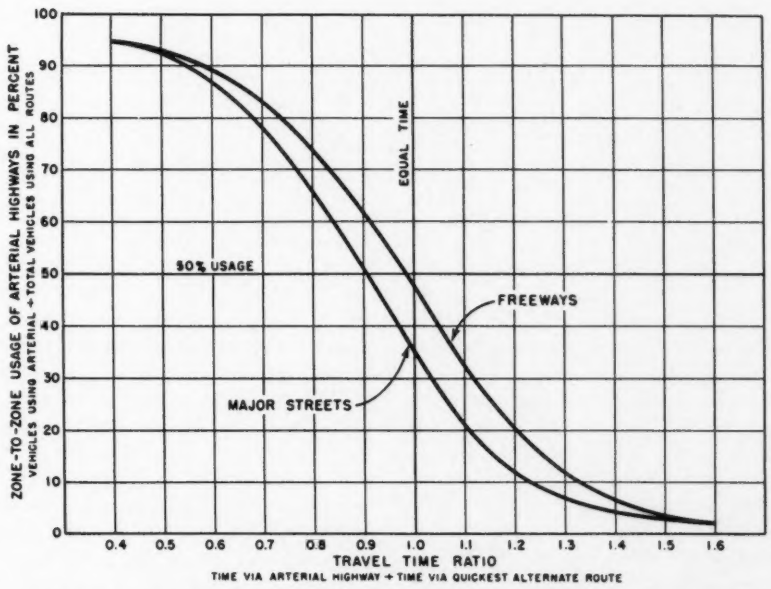
BRIEFLY STATED, traffic assignment is the process of estimating the traffic volumes that would use a proposed highway facility if it were built. This information is necessary for economic justification and geometric design of the facility. The traffic volumes to be assigned are usually the product of an origin and destination survey. The engineer may be interested in the estimated traffic volumes at several points in time. For example, the choices might be the initial or current year volumes, the volumes at some intermediate year for stage construction and the design year (usually 20 years hence) volumes. For the current year volumes, the origin and destination survey average daily traffic volumes are usually used for assignment. For the intermediate year and design year volumes, the O&D ADT must be forecast by some suitable forecasting method. (See the article on traffic forecasting in *Traffic Engineering*, May 1960.)

Statement of the Problem

The following passages are quoted from "A Policy on Arterial Highways in Urban Areas"[1]:

"Assignment of traffic proceeds by first superimposing on an area map, which shows all existing facilities, the location and preliminary design of the arterial in question, as well as the other highway improvements contemplated during the period of time designated for design (generally 20 years), including all points of access and intersections. The overall speeds of traffic on contemplated improvements are then estimated on the basis of experience on comparable facilities. Also, actual overall speeds and travel times on existing facilities are determined by field studies. With this information and known volumes of traffic between various zones of origin and destination, traffic is assigned to the proposed highway.

"The determination of what traffic would be attracted to a new highway and what would continue to use the existing facilities depends on comparative travel distances, travel times, and economy of operation. The choice is further influenced by the length of trip, comfort, safety, aesthetics, and habit. On the basis of a number of studies on traffic diversion[2] a practical and sufficiently reliable method of assigning traffic to specific routes has been developed. The method recommended is on the basis of travel time; i.e., the ratio of travel time via the improved route to the travel time via the quickest alternate route on the existing facilities between given points of origin and destination."



TRAFFIC DIVERSION CURVES FOR URBAN ARTERIAL HIGHWAYS

Figure 1
Time ratio diversion curves.

Traffic diversion curves for this purpose are shown in Figure 1.[3] Other similar curves have been developed and are in use. The state of California has developed a curve that incorporates both time and distance savings as the criteria for diversion to the proposed freeway system as shown in Figure 2. Each zone-to-zone movement that may be a candidate for assignment to the freeway system must be routed through the existing street system between the two terminal zones and the travel times accumulated for the route. At this point, care must be exercised to be sure to include all zone-to-zone movement routings, through the existing street system, that may be candidates for assignment to the various alternate

1 American Association of State Highway Officials, Copyright 1957.

2 **Traffic Assignment**, Highway Research Board Bulletin No. 61, 1952.

3 Reproduced from **A Policy on Arterial Highways in Urban Areas**, American Association of State Highway Officials, Copyright 1957.

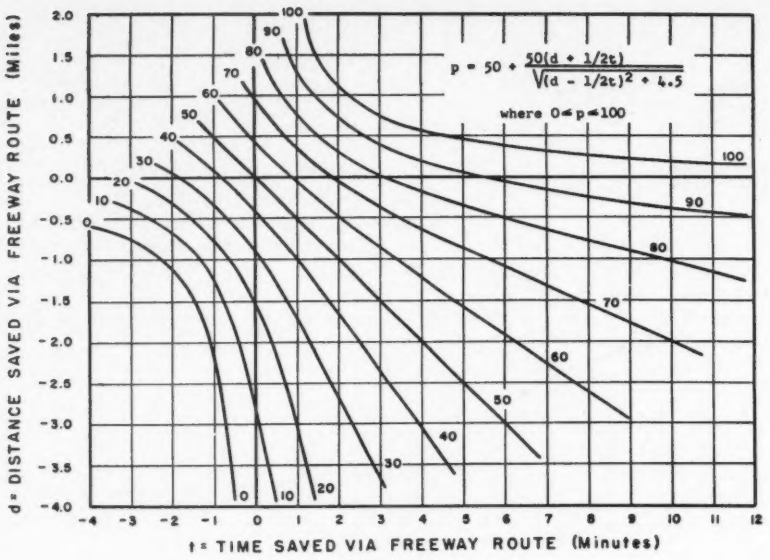


Figure 2
California time and distance savings diversion curve.

freeway locations to be analyzed. The total distance for each existing street routing must also be accumulated if a time and distance diversion curve is to be used. In many cases, distance is obtained when using a time ratio curve (even though it is not used in the assignment process) for subsequent calculation of vehicle miles on the proposed and/or existing street systems.

Each zone-to-zone movement must also be routed over the proposed freeway system even though the time and distance may be adverse to the routing over the existing street system unless it is quite obvious that the routing is so adverse that no part of the movement would be assigned to the freeway system. When the assignment is being done manually, a great deal of judgment is required in this process.

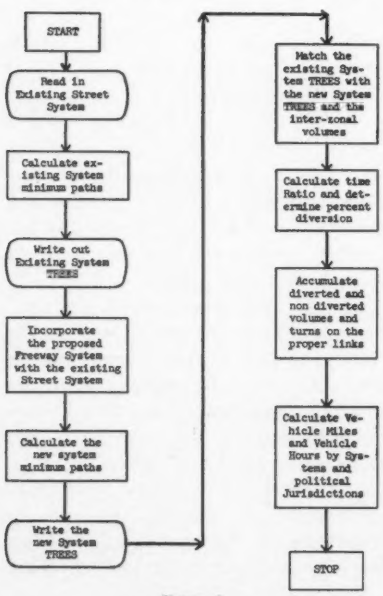

START
Read in Existing Street System
Calculate existing System minimum paths
Write out Existing System TREES
Incorporate the proposed Freeway System with the existing Street System
Calculate the new system minimum paths
Write the new System TREES
Match the existing System TREES with the new System TREES and the inter-zonal volumes
Calculate time Ratio and determine percent diversion
Accumulate diverted and non diverted volumes and turns on the proper links
Calculate Vehicle Miles and Vehicle Hours by Systems and political Jurisdictions
STOP

Figure 3
General flow chart for time ratio traffic assignment.

When this work has been done, two separate routings with the attendant accumulations of time and/or distance have been tabulated for a part of the zone-to-zone movements. If the assignment is to an isolated freeway route, many zone-to-zone movements would not logically be candidates for assignment. If the assignment is to a citywide system of freeways, a much higher percentage of the total zone-to-zone movements would be candidates for assignment to the system and therefore must be routed through it.

When a time ratio curve is to be used, the next step is to calculate the ratio of the travel time via the freeway system to the travel time via the existing system for each pair of routings. The diversion curve is then consulted to determine the percentage of each zone-to-zone movement that would divert to the freeway. The diverted volume is then calculated and accumulated on the various elements of the freeway portion of the routing. When all zone-to-zone movements that are candidates for assignment have been processed, the total estimated ADT for each element of the freeway is known.

It is quite obvious that an assignment to a comprehensive freeway network results in a tremendous volume of tedious calculations. Many procedures have been developed for punched card calculating equipment to ease the computing burden.[4]

Computer Developments

Electronic computer programs have been written for intermediate size computers to further speed the process but are for assignment to isolated freeway routes that usually require the routings for each zone-to-zone movement to be furnished as input. In one such program, the engineer furnishes the routings in terms of map inches at various speeds along with a map scale factor. The program converts from map scale to miles and time, determines the per cent diversion from a stored table representing a diversion curve and accumulates the diverted volumes on the various elements of the freeway. Such developments have been significant steps forward in relieving the engineer of burdensome work and speeding up the assignment process but a great deal of manual labor was still required.

The most tedious part of the work has been the selection of the routings. The American Association of State Highway Officials' Policy Manual states that the travel time ratio is the travel time via the freeway divided by the travel time for the quickest alternate. The engineer could never be sure that he had selected the quickest alternate. The selection had to be made by judgment and personal knowledge of the street system. This task could rarely be delegated to clerical help. If a complete citywide forecasted origin and destination survey is to be assigned to a comprehensive freeway network, there may be as many as 100,000 zone-to-zone movements to be routed with two routings being required for each movement.

Any attempts to develop a comprehensive computer program for assignment was always stymied by the route selection problem. A great step forward in the solution of this problem began with the presentation of two papers, one by Edward F. Moore titled "The Shortest Path Through A Maze," presented at the International Symposium on the Theory of Switching, at Harvard University in 1957, and the other by George B. Dantzig titled "The Shortest-route Problem" in Operations Research 5:270-3, 1957. The work of these two men was drawn upon in an

4 Traffic Assignment by Mechanical Methods, Highway Research Board Bulletin No. 130, 1956.

investigation by J. G. Haynes and F. C. Bock[5] of the Armour Research Foundation of Illinois Institute of Technology. This work was initiated and sponsored by the Chicago Area Transportation Study, Dr. J. Douglas Carroll, Jr., Director.

This investigation resulted in an electronic computer program for an intermediate size computer for finding the minimum time (or distance) path through a network. This program is a laboratory novelty in that it is limited to 18 nodes (intersections) and is quite extravagant of memory storage. It provided the beginning however for further development.

Dr. Carroll and his staff further refined the program on an intermediate size machine to such a point that they were able to accommodate enough nodes to encompass a small section of the Chicago metropolitan area. They then programed the minimum path concept for a very large high-speed computer containing 32,000 words of memory storage to assign traffic for the entire Chicago metropolitan area.[6] Further work in this area has been done by Dr. Mayer and his staff of the Detroit Area Transportation Study. Dr. Carroll's method assigns 100 per cent of the traffic between any two zones to the minimum time path.

The District of Columbia Highway Department in cooperation with the Bureau of Public Roads undertook the development of an assignment program that would conform to the principles set forth in the AASHO Policy Manual using the minimum time path principle. The programing was a joint effort involving Mr. G. E. Brokke of the Division of Highway Planning, Office of Research, Bureau of Public Roads, Mr. William Boardman, Acting Technical Director, Regional Highway Planning Committee, Washington, D.C., the General Electric Computation Laboratory, Phoenix, Arizona and the writer representing the Division of Development, Office of Operations, Bureau of Public Roads. This work has been successfully concluded and many assignments have been made with the programs. Since the writer has been intimately associated with this development, it will be described in some detail.

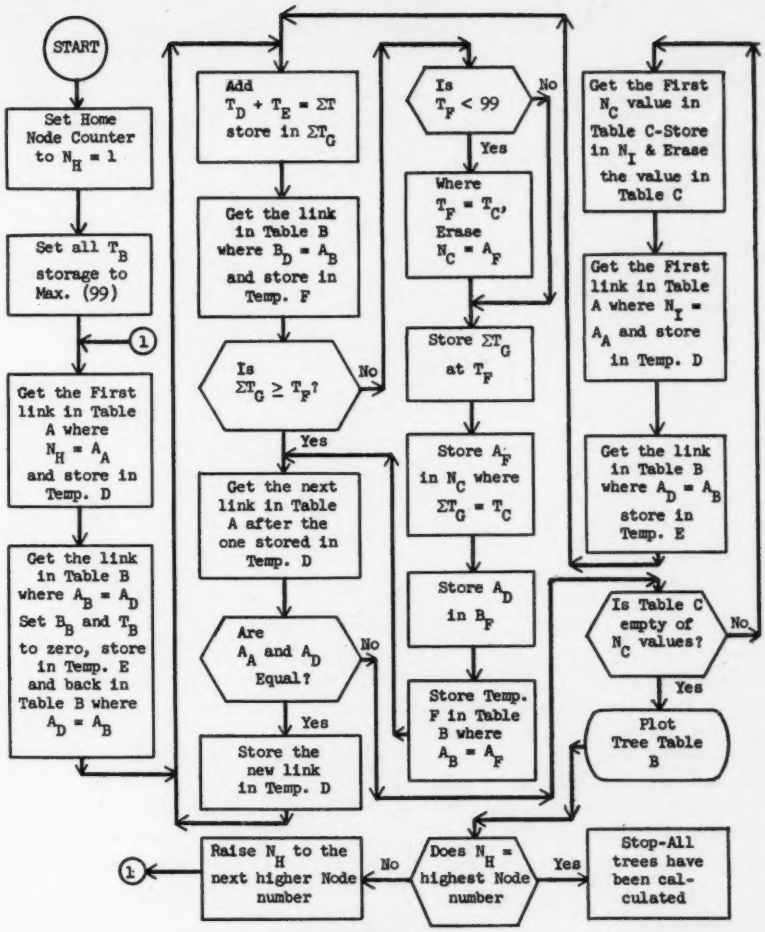

START
Set Home Node Counter to $N_H = 1$
Set all T_B storage to Max. (99)
1
Get the First link in Table A where $N_H = A_A$ and store in Temp. D
Get the link in Table B where $A_B = A_D$ Set B_B and T_B to zero, store in Temp. E and back in Table B where $A_D = A_B$
Add $T_D + T_E = \Sigma T$ store in ΣT_G
Get the link in Table B where $B_D = A_B$ and store in Temp. F
Is $\Sigma T_G \geq T_F$?
No
Yes
Get the next link in Table A after the one stored in Temp. D
Are A_A and A_D Equal?
No
Yes
Store the new link in Temp. D
Is $T_F < 99$
No
Yes
Where $T_F = T_C$, Erase $N_C = A_F$
Store ΣT_G at T_F
Store A_F in N_C where $\Sigma T_G = T_C$
Store A_D in B_F
Store Temp. F in Table B where $A_B = A_F$
Get the First N_C value in Table C-Store in N_I & Erase the value in Table C
Get the First link in Table A where $N_I = A_A$ and store in Temp. D
Get the link in Table B where $A_D = A_B$ store in Temp. E
Is Table C empty of N_C values?
No
Yes
Plot Tree Table B
Stop-All trees have been calculated
Does N_H = highest Node number
Yes
No
Raise N_H to the next higher Node number
1

Figure 4
Flow chart for minimum path route calculations.

Definition of Terms

The following nomenclature will be used in subsequent discussion:

1. *Node.* Any point on a highway system used for descriptive purposes, such as a street or highway intersection. There are three types of nodes: a. Zone population centroids; b. Existing street system intersections; c. Proposed freeway intersections.

2. *Link.* Any one way section of the existing or proposed highway system situated between two nodes, including hypothetical links connecting the zone centroids to the highway system.

3. *Link Travel Time.* The measured or estimated average travel time for a link.

4. *Link Distance.* The length of a link in miles.

5. *Existing System Routing.* The minimum time path over the existing street system between two zones centroid nodes.

6. *Existing-Plus-Proposed System Routing.* The minimum time path between two zone centroids via the existing street system and the freeway system.

7. *Existing System Tree.* The aggregate of all of the existing system routings from one zone centroid node to all others. There is one existing system tree for each zone centroid node.

8. *Existing-Plus-Proposed System Tree.* The aggregate of all of the existing-plus-proposed system routings via the freeway system from one zone centroid node to all others. There is one existing-plus-proposed system tree for each zone centroid node.

9. *Interzonal Volume.* The zone-to-zone volumes to be assigned. Intrazonal volumes need not be present since they cannot be assigned.

In the planning stage, the following

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5 **Investigation of Methods for the Assignment of Trip Demand to a Road Network—Phase 1—Algorithm for Finding the Shortest Paths Between Pairs of Points in a Network, Armour Research Foundation Project EO84—June 1957.**

6 **J. Douglas Carroll, Jr.—A Method of Traffic Assignment to an Urban Network—Presented at the 38th Annual Meeting of the Highway Research Board, January 1959.**

Table 1
Tabular storage associated with minimum path calculations.

LINK TABLE A

NODE A_A	NODE B_A	TIME T_A
1	32	5
1	34	12
1	35	3
2	31	4
2	33	10
30	32	4
30	35	4
30	36	6
31	2	5
31	34	2
31	35	7
32	1	7
32	30	2
33	2	3
33	35	7
33	36	2
34	1	8
34	31	7
35	1	10
35	30	8
35	31	6
35	33	5
36	30	8
36	33	6

TREE TABLE B

NODE A_B	NODE B_B	ΣTIME T_B
1	0	0
2	33	11
30	32	7
31	35	9
32	1	5
33	35	8
34	31	11
35	1	3
36	33	10

SEQUENCING TABLE C

ΣTIME T_C	NODE N_C
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	≠ 34
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	

TEMPORARY LINK STORAGE D

NODE A_D	NODE B_D	TIME T_D
34	31	7

TEMPORARY LINK STORAGE E

NODE A_E	NODE B_E	TIME T_E
34	31	11

TEMPORARY LINK STORAGE F

NODE A_F	NODE B_F	TIME T_E
31	35	9

HOME NODE COUNTER H

N_H	1

TEMPORARY NODE STORAGE I

N_I	34

TEMPORARY SUMMATION OF TIME STORAGE G

ΣT_G	18

objectives were established as desirable goals. The program should:

1. Conform to the standards of the AASHO Policy Manual.

2. Be general for any O&D survey area, large or small.

3. Be general for an isolated freeway route as well as a complete integrated system of freeways.

4. Assign traffic to the existing as well as the proposed highway systems.

5. Furnish all turning movement volumes on the existing as well as the proposed highway systems.

6. Assess a time penalty for each turn executed, the amount of the penalty time to be determined by the user.

7. Be economical enough to allow several analyses to optimize the proposed system location and/or geometry.

8. Allow choice by the user of the time-ratio diversion curve to be used.

9. Provide for 100 per cent assignment (no diversion curve used) to the minimum time path as an option. These objectives were all successfully met.

The input for the program consists of three files:

1. All of the links that connect to each node with their associated travel time and distance. This results in two links for each section of street between two nodes, one for the travel in one direction and one for travel in the other direction even though the travel times would logically be the same in both directions for non-directional assignment.

2. A "triangular" file of the zone-to-zone volumes to be assigned. (See the previous article on forecasting.)

3. A table representing the diversion curve to be used. A very general flow chart of the procedure is presented in Figure 3.

Sample Problem

All of the procedure is quite easy to understand except perhaps the calculation of the minimum path trees since this was the development that made the assignment program possible. A highly simplified flow chart of the tree calculating process is presented in Figure 4, the related tables and calculations in Table 1 and the hypothetical street system in Figure 5. The numbers associated with the arrows between the nodes are the hypothetical link travel times. Note that this same information appears in link Table A. In this example, the two travel times for a section of street between two nodes are different to illustrate that the minimum path program can compute directional routings. For the assignment of a "triangular" table of interzonal movements, the travel times would logically be the same in both directions since the volumes are the same in both directions. There are as many entries in Table A as there are directional highway links.

Examination of Figure 5 will show that the node numbering does not have to be systematic spatially. For example, node 35 does not have to be contiguous to nodes 34 or 36. There are no restrictions on the geometric configuration of the street system to be coded. There are numbering restrictions however. The zone centroids must be numbered serially beginning with one. In the actual program as developed, the zone centroids are the low order node numbers, the existing street system nodes are the next higher and the freeway nodes have the highest numbers.

For ease of presentation, the flow chart in Figure 4 and the hypothetical street system in Figure 5 have been made as simple as possible. Sample

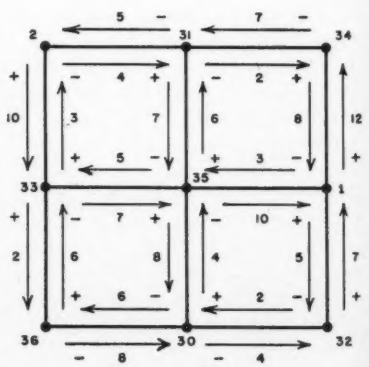


Figure 5
Schematic of a hypothetical street network.

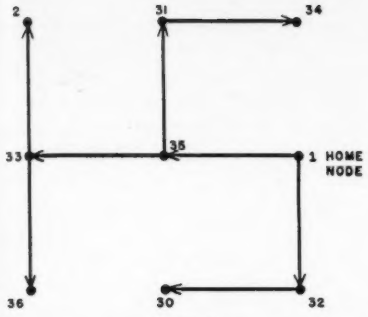


Figure 6
Minimum path tree from node 1 to all other nodes in a hypothetical system.

values are shown in Table 1 for the condition of the various storage areas at the conclusion of the calculation of the first tree to obtain the minimum time paths from node one to all other nodes as shown in Tree Table B and as graphically shown by the path arrows in Figure 6.

It is recommended that the reader calculate a tree for himself by following through the flow chart. It will be seen that Table 1-C has the function of causing the most likely paths of all those possible to be found first since the exits from the node that lies least time distant from the home node are always selected for the next outward search. This results in economy of machine running time. The reader can verify that the minimum time paths from the "home" centroid node to all other nodes can be calculated by processing each link in Link Table A only once.

In the actual program, there is a time penalty constant (the magnitude determined by the user) applied for each turn executed in the existing street system. This penalty is not applied in the freeway system. This causes zigzag routes to be less attractive as minimum path candidates during the tree-building process. This is accomplished by signing each link such that when the routing is through links of like sign, no penalty is applied and when the routing is through links of unlike sign, the penalty is applied. There is provision in the link input data for two single-character flags such that the engineer can make the penalty system work in odd geometric situations or he may suspend the penalty at specific intersections. He may dispense with the turn penalty entirely if he wishes.

Two or more hypothetical links must be inserted to connect each zone centroid to the existing street system, to provide at least one entrance and one exit for the centroid.

The engineer has the option of allowing the program to route traffic through intermediate zone centroids that are not terminals of the movement or designating that no zone centroid will appear on a routing except as the origin or the destination.

After trees have been calculated from all zone centroids for the existing street system, a second set of trees must be calculated for the existing system with the proposed freeway system added. This may be done by either making the necessary additions and corrections and inserting them in the original input file or by supplying only the additional data and using a program to update Table A.

Forcing Freeway Use

When calculating the existing-system-plus-freeway-system trees, there is an additional restriction to the tree building program. The traffic must be forced to use the freeway system for a part of each zone-to-zone movement, if it is at all feasible, even though the routing may be adverse time-wise when compared to the existing system routing. If this were not the case, no time ratios greater than 1.0 as shown in Figure 1 would occur. This would render the right-hand portion of the diversion curve useless. It doesn't matter if forcing the movement onto a freeway results in a very high time ratio, because any ratio greater than the limits of the curve will result in zero percentage of the interzonal volume assigned to the route involving the freeway.

The process of forcing the traffic onto the freeway system was accomplished by having the program halve the travel time values for all freeway links automatically. This has the effect of making the freeways very attractive minimum path candidates. The freeway travel times are converted back to their original values before time ratios are computed.

Figure 7[7] shows the result if the freeway travel times were left at their full values during the tree-building process. (Refer to Figure 8.) The sum of the travel times for GC + CD + DH must be less than GH for the program to establish that E G C D H F is a minimum time path. Ideally, routings that involve portions of a freeway are desired in all cases where the time ratio is 1.50 or less. Time ratios greater than 1.50 would result in zero assignment to the freeway so routings over the freeway system are not required. In Figure 8, the time ratio is (GC + CD + DH)/GH. Referring to Figures

7 All subsequent references to a time ratio curve are based on the Bureau of Public Roads curve rather than the one shown in Figure 1. The Bureau of Public Roads curve has time ratio limits of 0.5 and 1.50.

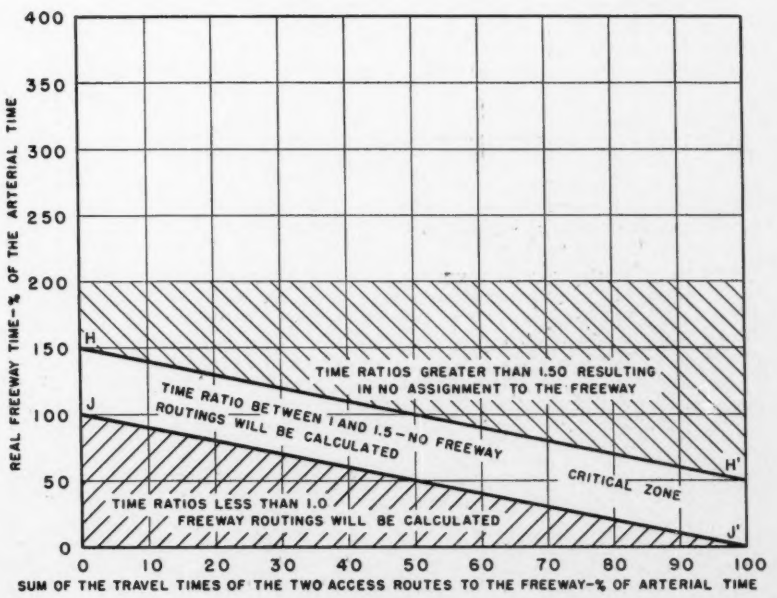
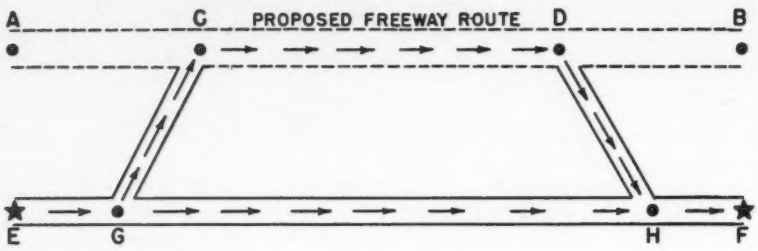

400
350
300
250
200
150
100
50
0
REAL FREEWAY TIME-% OF THE ARTERIAL TIME
H
J
TIME RATIOS GREATER THAN 1.50 RESULTING IN NO ASSIGNMENT TO THE FREEWAY
TIME RATIO BETWEEN 1 AND 1.5 – NO FREEWAY ROUTINGS WILL BE CALCULATED
CRITICAL ZONE
TIME RATIOS LESS THAN 1.0 FREEWAY ROUTINGS WILL BE CALCULATED
H'
J'
0 10 20 30 40 50 60 70 80 90 100
SUM OF THE TRAVEL TIMES OF THE TWO ACCESS ROUTES TO THE FREEWAY-% OF ARTERIAL TIME

Figure 7
Freeway route calculations at full freeway time. The unshaded critical zone indicates the region in which freeway routes are desired but not calculated.



AB = Proposed freeway route
E & F = Terminals of an interzonal traffic movement
EGHF = Routing from E to F via existing street system
EGCDHF = Routing from E to F via the freeway
GC & DH = The portions of the existing street system used to gain access to the freeway

Figure 8
Schematic example of diversion to a freeway.

7 and 8, if GC + DH is zero, the time ratio is CD/GH. In any case where CD is 150 per cent of GH or greater, all time ratios would be greater than 1.50 or beyond the limits of the diversion curve which would result in zero assignment to CD. If GC + DH is equal to 100 per cent of GH, the time ratio will be 1.50 or greater in all cases where CD is 50 per cent or more of GH. This establishes the line HH′ in Figure 7.

If GC and DH are zero, any case where CD is 100 per cent or less of GH will result in E G C D H being a minimum time path so a routing that involves the freeway will be calculated. If the sum of GC + DH is 100 per cent or more of GH, E G C D H F is not a minimum path so no routing involving a portion of the freeway will be calculated. This establishes the line JJ′ in Figure 7. All cases that fall between the two lines would have time ratios between 1.00 and 1.50 indicating some diversion to the freeway but the diversion routings would be the same as the existing street system routing which would result in 100 per cent of the volumes being assigned to the existing street system.

Figure 9 shows the situation resulting if the freeway travel times are halved during the minimum path tree-building process and then restored to their original values before time ratios are computed. The unshaded triangle shows the critical area where time ratios will be between 1.00 and 1.50 but no routings involving a portion of a freeway will be calculated. Note that the area has been reduced to 25 per cent of that shown in Figure 7.

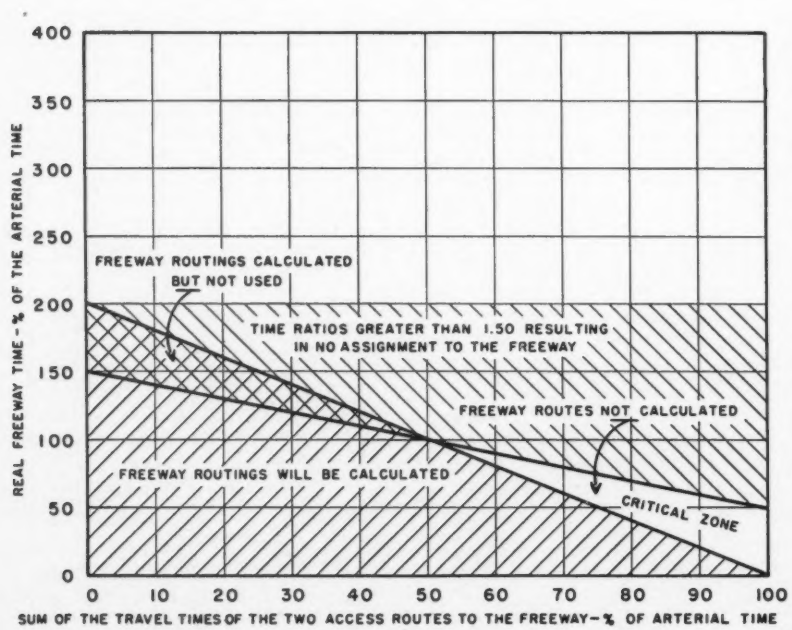


Figure 9
Freeway route calculations at one half time. The unshaded critical zone indicates the region in which freeway routes are desired but not calculated.

Figure 10 shows what would result if the freeway travel times were cut to 1/4 of their original values during the minimum path calculations. The critical area in this case is 8.5 per cent of that shown in Figure 6. However, investigation has shown that routings become somewhat unrealistic when the freeway travel times are reduced by more than one-half.

Figure 11 is a plot of the critical area versus the factor to which the freeway time is reduced. Cutting the freeway times to zero would force all routings onto a freeway but the criterion for determining the freeway portion of the routing would be lost. For example, if a trip entered an outer belt freeway and wanted to leave the freeway after a short distance, zero freeway time might route the trip completely around the city to the exit point. The problem of forcing freeway use in cases where the time ratio is between 1.00 and 1.50 has been discussed in detail to furnish the engineer with the information necessary to decide what the magnitude of the freeway time reduction should be to meet his needs. This problem is not unique to this program. In previous assignment methods, the engineer usually had to decide by intuition and judgment what interzonal movements would not be candidates for freeway system use.

Assignment of Volumes to Routes

After both the existing street system routings and the existing-plus-proposed-system routings have been calculated, two routings exist for every possible interzonal movement. In the final phase of the program, the two trees that contain all routings from one zone are matched with the interzonal volumes between that zone and all others. As each zone-to-zone volume is processed, the routings for the corresponding zones are extracted from the trees. The two routings for a particular volume are paired, and the points where the two routes diverge and

where they again converge are determined. These points correspond to G and H in Figure 8. In the extreme case the routings would diverge at the zone centroid and converge at the other zone centroid. The time ratio is then calculated for the portions of the routes that lie between the points of divergence and convergence, and the per cent of the interzonal volume to be diverted to the routing containing the freeway is found from a diversion curve stored in tabular form. The volume is then split according to the diversion percentage and accumulated on the various street and freeway links of the two routes with 100 per cent of the volume being assigned to the portion of the routes that are identical. During the process, all turning movement volumes are also accumulated on both the existing street system and the freeway system.

There is also provision in the program for bypassing the diversion procedure to assign 100 per cent of the interzonal volumes to the minimum time path in a system which includes the proposed freeways if the user desires. This requires that only one set of trees be calculated.

At present, the program can accommodate not more than 4000 nodes and no node may have more than 4 exits. For intersections that have more than four exits, extra nodes may be inserted with zero time and zero distance in the appropriate links to form as complex an intersection as desired.

The program has been used for a system of 438 zones with a total of 3500 intersections. The machine running times were as follows:

1. Calculate existing street system trees—1 hour and 30 minutes or about 13 seconds per tree.

2. Calculate existing street system plus freeway system trees—1 hour and 30 minutes.

3. Calculate diversion and load the volumes on the network—1 hour.

4. Calculate vehicle miles and vehicle hours by system and political subdivisions—10 minutes.

5. Load volumes 100 per cent to the minimum time path—35 minutes.

Directional Assignment

Subsequent to this development, the Minnesota Highway Department undertook to make the necessary additions to the system such that directional interzonal volumes can be assigned. This work was also done in cooperation with the Bureau of Public Roads and the General Electric Company.

If the reader will review the tree-building process, he can confirm that it requires no modification to compute directional routes. The principal differences are that a "square" table of interzonal volumes must be provided such that a volume is listed for both directions between two zone centroids and that the volumes are loaded on the links with regard to direction and that directional turning movements are computed. This last feature required extensive additional programing effort since there are twelve possible directional movements at a four way intersection. The Minnesota Highway De-

(Continued on page 53)

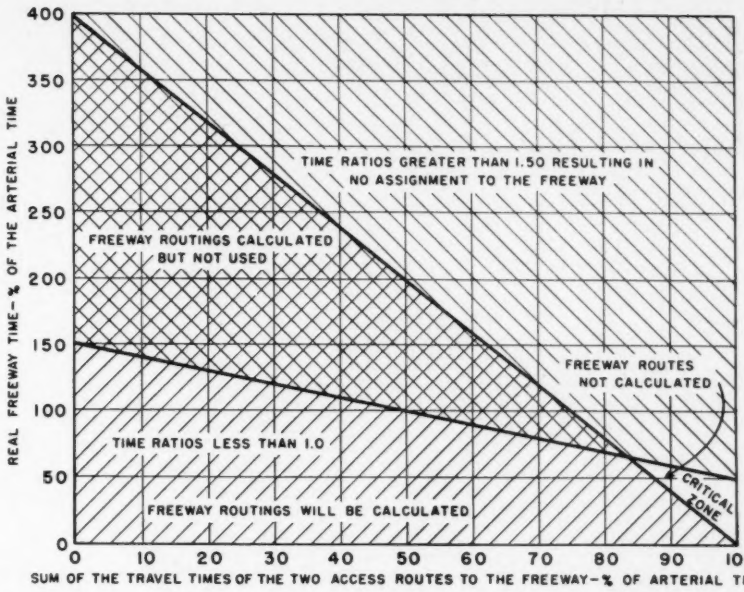

REAL FREEWAY TIME - % OF THE ARTERIAL TIME
400
350
300
250
200
150
100
50
0
TIME RATIOS GREATER THAN 1.50 RESULTING IN NO ASSIGNMENT TO THE FREEWAY
FREEWAY ROUTINGS CALCULATED BUT NOT USED
FREEWAY ROUTES NOT CALCULATED
TIME RATIOS LESS THAN 1.0
CRITICAL ZONE
FREEWAY ROUTINGS WILL BE CALCULATED
0 10 20 30 40 50 60 70 80 90 100
SUM OF THE TRAVEL TIMES OF THE TWO ACCESS ROUTES TO THE FREEWAY - % OF ARTERIAL TIME

Figure 10
Freeway route calculations at one fourth time. The unshaded critical zone indicates the region in which freeway routes are desired but not calculated.

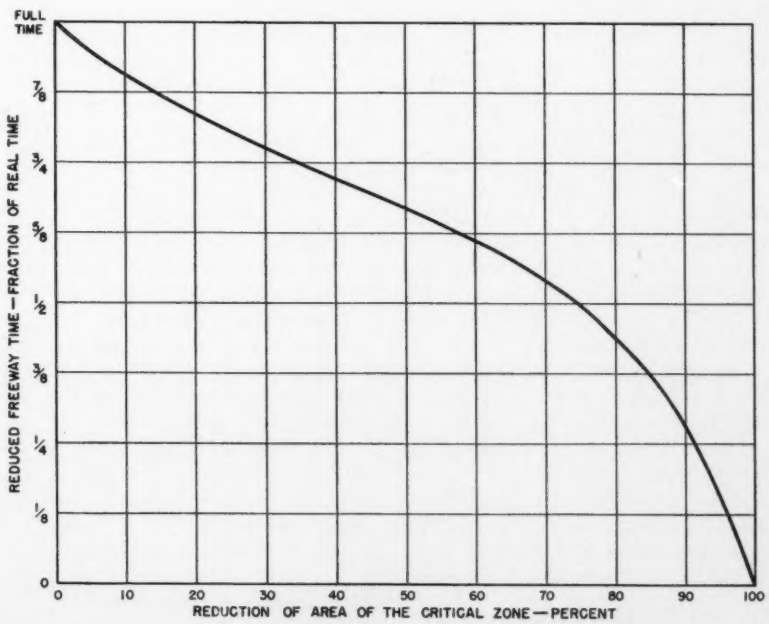


Figure 11
Relation of the critical zone area to the freeway time reduction.

Building A Second United States

By John Noble Richards, FAIA, Toledo, Ohio

There is a growing realization that the urban problems of this country are too big to be solved by independent action of even a number of groups or disciplines. Among the groups having an interest in these problems are the architects, along with the traffic engineers, planners and others. Here is a forthright expression of the interest of the architectural profession by the immediate past president of the American Institute of Architects. Mr. Richards spoke before the Michigan Section of the Institute of Traffic Engineers on April 28, and his remarks are printed here with his special permission.

I AM HONORED indeed to have been invited to speak to the Institute of Traffic Engineers. I consider your invitation to an architect a symbol of the growing cooperation between traffic engineers, planners and architects. It denotes the increasing importance of the architect's contribution to community planning.

One: It is essential that community planning — urban, metropolitan and suburban building and re-building, be supported by the public and our state and Federal government. In fact, without public support, it just won't work to the extent it must work.

Two: It is important that traffic engigineers, architects and planners work together.

As you know, we, the people of the United States, are faced with a tremendous challenge. Before this century is out—and that is only forty years away—we shall have to build the equivalent of another United States and then some.

We must double all the structures that now exist. And the job must be done before the children born in 1959 reach middle age.

Never in the long history of our profession have traffic engineers, planners and architects faced such an awesome responsibility and such unprecedented opportunity.

To present the case a little more specifically, we must build 50 cities the size of Boston in the next 10 years. It is anticipated that there will be 600 billion dollars worth of building in those 10 years.

Our country has rightly been described as "the mess that is man-made America."

I need not elaborate.

As we approach our cities—most of them anyway,—we are forced to travel through a turbulent sea of ugliness.

At best these approaches are makeshift amusement parks . . . at worst they are unspeakable slums.

I said a sea of ugliness. It is a quagmire of ugliness, for we get stuck and bogged down in it most of the time. It often seems that the motorcar prevents rather than facilitates transportation.

When we have finally made it into the core of our cities, where are we? More often than not we seem to be in the mouth of some decaying, pre-historic monster which had a lot of his teeth knocked out. There are used car lots in these gaping cavities and more billboards and pizza stands.

To be sure, some of the monster's teeth are braced with pretty gold plating—to attract the customers. But, like the gold teeth in the mouth of an old woman, they only make the rest of the dentures look all the more awful.

As the late and great Frank Lloyd Wright has put it:

"We have urbanized urbanism until it is a disease. The city is a vampire living upon the fresh blood of others, sterilizing humanity . . . The push-button civilization over which we are gloating has suddenly become a terror."

I am generalizing, of course. There are notable exceptions. We have a few attractive cities and there are some beginnings of city planning, and planned cities.

But I am not really exaggerating. At least the millions of people who flee our cities each year don't think so. They are rushing out and transforming our lovely American countryside into an unplanned, jerry-built, helter-skelter mess called "suburbs".

The sea of ugliness is spreading. It threatens to drown us.

And that is our environment.

I am not blaming anyone. We have been a busy people. In a short span of years we have transformed the rugged primitive life of pioneers into the highest (and softest . . . and most complex) standard of living ever lived by any people in history.

We have been in the throes of enormous technical and industrial revolution.

And we have managed to stick to our ideals of democracy and freedom and actually consolidate these concepts.

But we have not attained the visible manifestations of culture. We have too little beauty, too little liveability, too little human dignity, in our environment.

Our population expansion and the desperate need to replace obsolete structures — dilapidated hospitals, schools that are firetraps, and crime and vice-breeding slums—are giving us another chance.

We have the opportunity, as I see it, to turn our country — man-made America—from a mess into an efficient, harmonious, liveable and beautiful environment.

I know this is saying quite a mouth full.

I don't believe in Utopia and—with all due respect for our city—I don't

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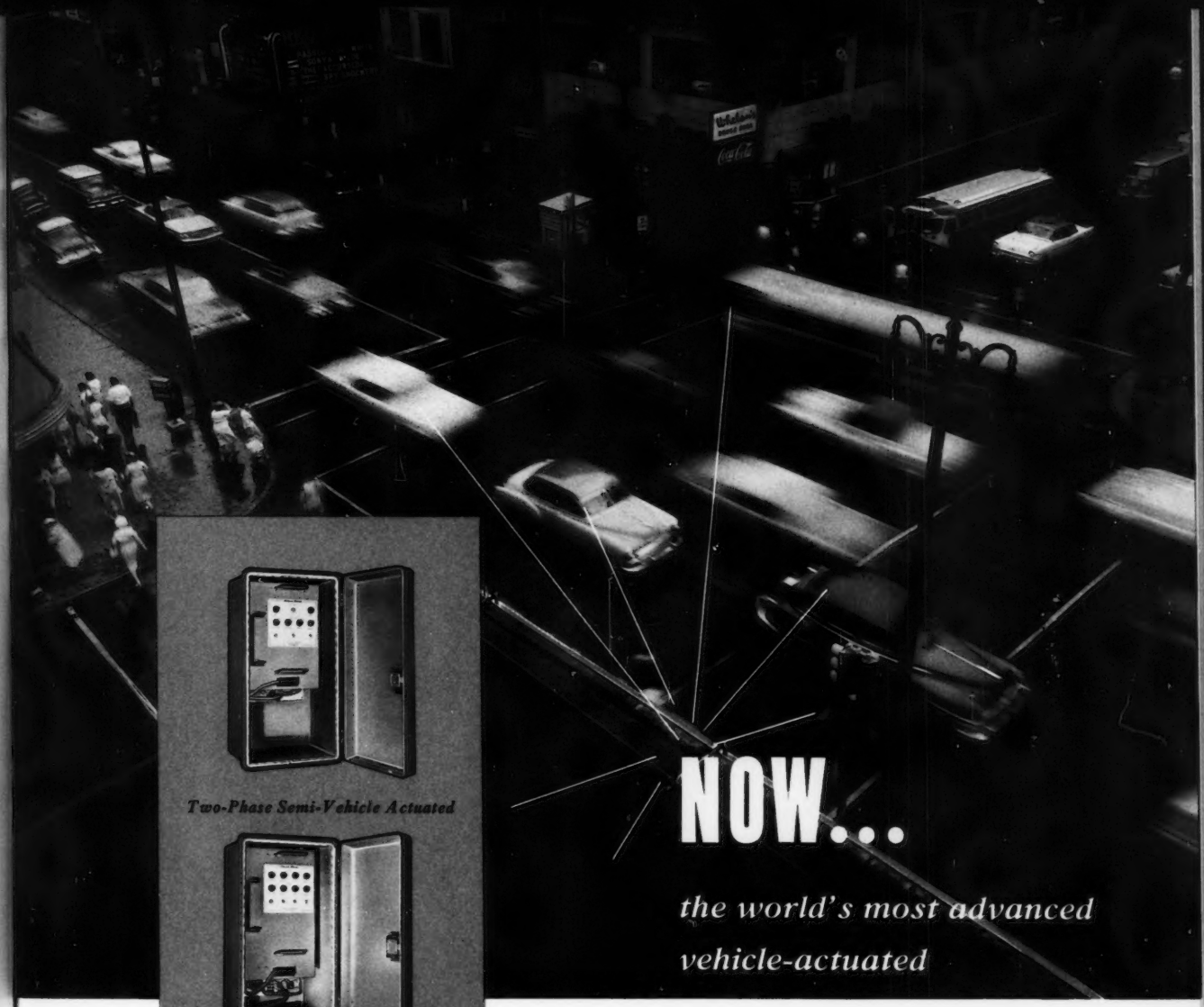

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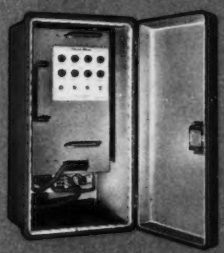

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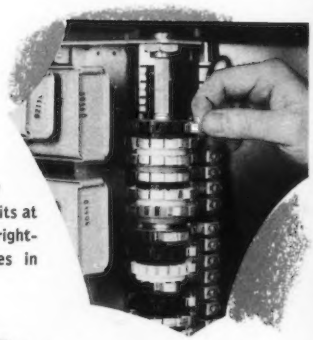

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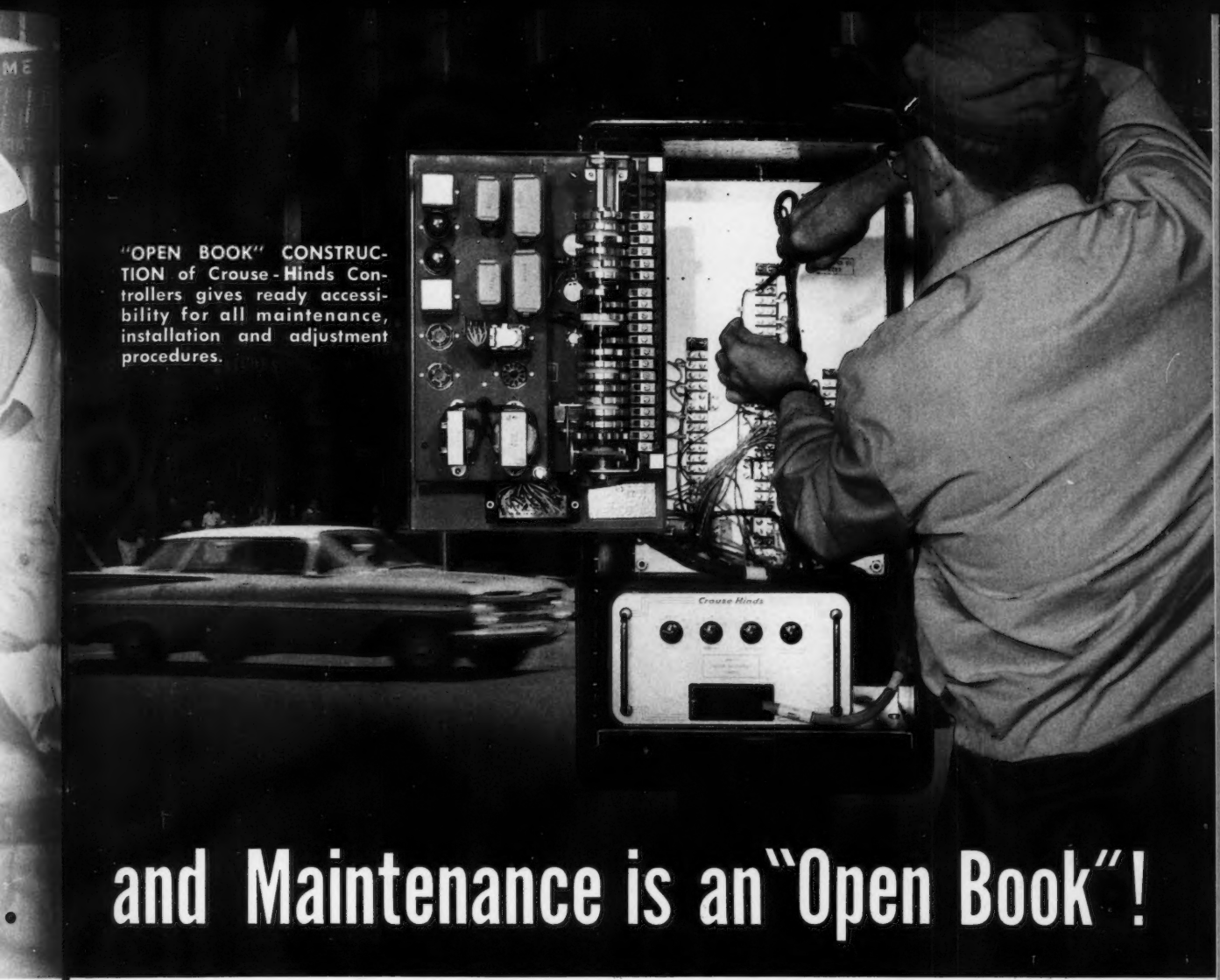

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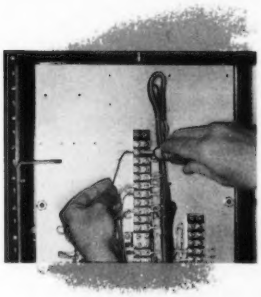

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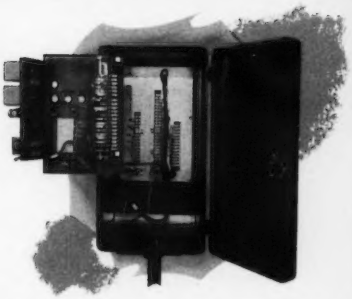

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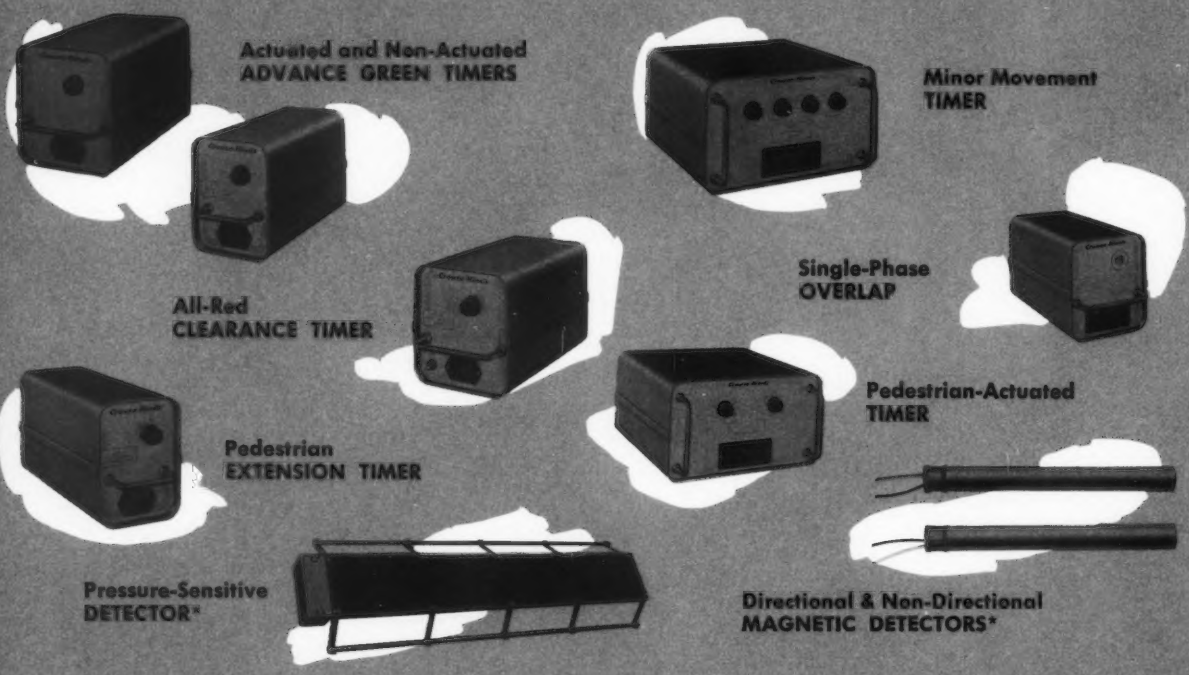

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A SECOND UNITED STATES

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believe we can ever turn a Toledo into a Paris.

But we do have an unprecedented opportunity to do better, much better than we have in the past.

Now how do we do it?

This generation of Americans will not fulfill its obligation to the next if we continue at the discouraging slow pace in which we have been going.

This is not to say that there aren't fine beginnings of comprehensive urban renewal and proper planning all over the country. We can be proud of them. But our cities need help, far more help than they are getting.

Baron Munchhausen may have been able to pull himself up by his own bootstraps. Our cities can't. We must stimulate public interest.

And this public interest must be asserted by all of us through effective political action.

This is one important area where traffic engineers, architects and planners, together with all the other segments of the design professions and the building industry, must get together and work together.

In Detroit, for instance, the cooperation between the planners, the architects, the highway designers and the traffic engineers has resulted in a coordinated program which has aided in the orderly development of the city.

We must arouse public opinion.

We must do far more than we are doing to arouse industry, the merchants, the civic leaders and the public in general to the need of good planning. Together we must exert pressure on our municipal, state and Federal authorities to get on with the job.

On and off planning and renewal won't do. We need continuity. As the current census will confirm, the vast majority of American citizens now live in cities and metropolitan areas. Our cities are a Federal problem. And while charity may begin at home, the effective rehabilitation of our cities must begin with our Federal government.

But our Federal and state governments will not respond to the extent that they should unless the ordinary citizen becomes aroused and starts building that fire.

Our people like the end-result of planned building and re-building. But they accept it as an act of God and not something they must fight for.

Why?

I believe anthropologist Margaret Mead is right when she wrote recently:

"We, none of us," she said, "take joint responsibility for the city streets, the conglomoration of water tanks and occasional pleasant pinnacles which we call a skyline, on which our children's eyes must be fed, and so we turn a blind eye to ugliness. Our unplanned towns and sprawling developments, our unwillingness to adapt a new building to the line of buildings already there, have bred a people who expect beauty to be a piece of private property for which they take no responsibility."

And there you have it—responsibility!

It is this word, I believe, which is still lacking, or at least not sufficiently strong in the vocabulary of community planning today.

Responsibility.

Most of us don't like to hear this word. It has been overworked. People don't like to be told what their responsibility is. And heaven knows we have enough problems—problems of crushing magnitude.

I need not enumerate them — the problem of adequate defense in a period of world-wide ideological conflict . . . the problem of harnessing atomic energy, not for destruction, but for the good of man . . . the problem of satisfying the rising hunger for food and human dignity among the people of the world . . . and the new problems of the space age.

Nor need I point out that the complexities of all these problems and our growing realization that there are no absolutes, no black and white, no good and evil—that our new awareness of the relativity of all things—often give us a sense of frustration.

And this sense of frustration seems to lead to apathy and—yes—growing moral corruption.

Yet, I repeat that a better, a more liveable, a more beautiful human environment is our first priority today. We can no longer afford to needlessly add to our frustrations with ugliness, slums, traffic jams and congestions. We may not be able to solve the problems of the world for a long time. But we can and must solve the problems of our cities, of our man-made environment.

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To some extent this is just a matter of raising our own morale, in much the same way that a man beset by complex difficulties will buy himself a new tie, or a woman a new hat. We desperately need the lift of a beautiful building, a well designed street, or an attractive downtown mall where people can relax and perhaps enjoy the play of a fountain or the beauty of a sculpture against some greenery. There was joy in the faces of our people when we tried this in Toledo last summer.

But more than that is at stake.

As I have said many times around the country:

The way we build the second America will determine whether our civilization and our culture . . . yes, and our very political ideals of democracy and our economic ideals of free enterprise . . . will succeed or fail.

Traffic congestion, land, water, and air pollution, slums and squalor, ugliness and chaos in our cities and our suburbs will spell failure—no matter how many missiles we manage to shoot at the moon.

Man builds an environment to satisfy his emotional desire for beauty as well as his physical need for shelter.

This man-made environment is ARCHITECTURE: MAN'S SPACE.

Even primitive man felt the need for more than just shelter in his space—the cave. He decorated the walls of this natural enclosure with history's first effort at art.

But when man builds his own space, he tries to achieve comprehensive beauty which is more than just decoration.

Man-made environment is both space within and the sequence of spaces between structures. Our great American poet, Walt Whitman, said "Architecture is what buildings do to you." It's what the spaces within and around a building do to the individual that is man's concern.

In addition to protecting and organizing activities for work . . . for play . . . for worship . . . space can provide an emotional response which enriches the activity of man.

It is this emotional response we receive from real architecture, whether it be in a church, an office, or a home.

This experience of beauty can be achieved in many ways.

Texture, structure, color and light, surface and form, are materials used to create space which will satisfy man's emotional desire for beauty.

And that word—beauty—leads me into my closing thought:

Sensible traffic solutions, open spaces, fresh water and clean, liveable, enjoyable and beautiful cities, lasting attractive buildings, will mean success . . . success for democracy and our American way of life . . . no matter how many sputniks Mr. Khrushchev sends up.

We must move with speed and determination.

And now to my second point:

There was a time when we architects thought primarily in terms of the individual building. That time is past.

We must think and do think in terms of the total environment and that environment must be planned. Planned on a human scale—for people.

We architects now consider the problems of urban decay and development very much a part of our responsibility.

In Kansas City, for instance, the local chapter of The American Institute of Architects has actually donated thousands of manhours to develop a workable downtown renewal plan. Similar efforts—many of them on a voluntary basis—are made by architects in many other communities.

The architect's first duty is to his client, of course. But he also has his client in mind when he thinks beyond the client's building.

The individual building in the community does not stand by itself. Its physical and human environment is vital. Its purpose is to serve people who require light, clean air, green space for recreation, properly balanced traffic flow, playgrounds for their children, convenient services, and the myriad other things which come under the general heading of planning.

Planning for people.

This requires a multitude of talents and a variety of complex knowledge. We need all the experts and skills. But someone must correlate the information of a great many engineers, planners, landscape architects, sociologists, and artists, together with the work of many other consultants, and create out of it a coherent, functional environment that is also esthetically pleasing.

The architect has a definite function in this—in fact an indispensable one.

As I have said—we must learn to work together as a team.

This team, let me add, must also include the artist, the sculptor, the painter.

There is a growing desire for *beauty* among the American people. And there is increasing evidence of this desire.

One instance is a recent ordinance by the city fathers of Philadelphia. In that city, one per cent of the construction cost of every public building will henceforth be devoted to some art work to enhance that building.

Another example is the appointment of an art advisory council on the arts to assist the New York Housing Authority in introducing art works into its projects.

These and other developments around the country are the first robins heralding a new spring in the building arts. But I think it is far too early as yet to pat ourselves on the back and to talk about a new renaissance.

We are progressing toward this renaissance, however, as evidenced by many new buildings which have considered *space environment*, such as Seagrams in New York and the new Libbey-Owens-Ford building in Toledo.

And speaking of space—this nation needs to be aroused to the problem of its vanishing open space—because *space is our most precious commodity.*

Steps must be taken to halt the invasion of farms and forest by industrial and housing developments. Otherwise there will be no open spaces left within a reasonable distance of the urban population.

If we keep up this "helter skelter" building there will be neither scenic attractions nor recreational facilities for an urban population, which will, someday, have more time to walk and play and enjoy the flowers.

Open space has the function of stopping one city from growing into the other and preventing the endless monotony of signs, billboards, pizza stands, used car lots and what not.

It seems to me that Federal, state and local governments must engage in extensive land acquisition programs in order to provide buffer areas of green space around cities, and to furnish the recreation area that a nation with more and more leisure time will need.

Such a program must be carried out in conjunction with land for new highways. This would help prevent continuity of development along the highways and thus avoid excessive concentration of traffic loads.

We must have master plans for the *metropolitan regions.* They must be imaginative, up to date plans.

Thus—to get such plans requires strong business leadership and top professional staffs—together with public enthusiasm and political support.

The sculptor Richard Lippold has stated it well when he said: "The truly creative man has faith in his time."

We must have faith in our time—the faith that our efforts on behalf of the building arts and a more beautiful man-made America can be as successful and as great as any in the periods before us.

We must have faith that we can arouse the public to its responsibility for the streets we walk on and the cities we live in. And that through arousing the public, our cities and their planners can get the financial means to get the job done.

We must have the faith to work together as a team—architects, planners, artists, engineers . . . all of us. And to work as effectively and tenaciously as though the survival of our American way of life depended on how well we build the Second United States.

Because, I sincerely believe, it does.

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Traffic News

Traffic Engineering At 8th Pan American Highway Congress

Subjects related to the operation of streets and highways were prominent on the agenda of the 8th Pan American Highway Congress held in Bogota, Columbia, May 20 to 28. Traffic engineers and traffic officials were active in the discussions of the five committees and their numerous working groups.

With a large part of the construction of the Pan American highway now completed, under contract or definitely programmed, more and more attention is being given by the Congress delegates to operating problems, traffic engineering, urban transportation planning and traffic safety. In these areas the delegates from the United States were of particular assistance, especially since five of the eleven members of the U. S. delegation were members of the Institute of Traffic Engineers.

It is significant that the largest number of papers and documents handled by any one committee was by the Committee on Traffic Engineering and Safety, organized at the 8th Congress for the first time. Engr. Manuel Amaya Leclair of Nicaragua was elected Chairman of his group and ITE member Burton W. Marsh was elected Vice Chairman.

Culminating from these discussions, specific resolutions related to traffic engineering were adopted at the plenary sessions in the following broad areas:

1. To urge the creation of a permanent technical committee, with staff, within the Pan American Highway Congress organization; to deal with traffic and safety problems on a continuing basis.

2. To encourage greater uniformity of traffic control devices among all the countries of the Americas and to bring these standards closer to those proposed by the United Nations.

3. To encourage the holding of periodic meetings and seminars for traffic officials of the Americas. Great interest was shown in the World Traffic Engineering Conference to be held in Washington, D. C., in August 1961, in conjunction with the 31st Annual Meeting of the Institute of Traffic Engineers. It was in fact voted to hold an already agreed-upon 1961 seminar for traffic specialists of the American countries in conjunction with this World Traffic Engineering Conference in Washington.

4. To urge the inclusion of traffic engineering courses in the civil engineering curricula of the various Universities in the Americas. Further, to encourage the creation of scholarships in this field and the exchange of students and teachers between Universities.

5. To stimulate urban transportation planning in the metropolitan areas. Reference was made to the program of the National Committee on Urban Transportation and its adaptation to Latin American countries.

6. To urge that traffic, safety and planning data be gathered by each country and disseminated widely for the benefit of all traffic officials.

7. To develop special studies of problems relating to night driving.

8. To publish all of the papers presented on subjects relating to traffic operation, safety and planning in a separate Congress document for wide distribution to traffic and highway officials.

The United States delegation was headed by Federal Highway Administrator, Bertram D. Tallamy. ITE President, Ed Wetzel represented the Port of New York Authority, J. O. Mattson represented the Automotive Safety Foundation, Karl M. Richards the Automobile Manufacturers Association, and Burton W. Marsh the American Automobile Association. The Institute of Traffic Engineers was represented by D. Grant Mickle. Other U. S. delegates represented the Congress of the United States, the American Society of Civil Engineers, American Bridge, Tunnel and Turnpike Association, the Bureau of Public Roads, the Associated General Contractors of America, the U. S. State Department and the American Road Builders Association.

In a few years it will be possible to travel overland on good roads all the way from Alaska to the southern tip of Argentina. The Pan American highway, which will link all the nations of North and South America, comprises a system of 18,800 miles. Of this total, 16,250 miles of all-weather

road are already in service, as well as 1,672 miles of dry-season road.

The only gaps remaining are a 20-mile portion in Guatemala, a 139-mile stretch in Costa Rica and the 465-mile Darien sector in Panama and Colombia. The first two are now under construction. On the third, which runs through jungle and marshland, only preliminary exploration has as yet been made.

Just previous to the Bogota meeting, two survey vehicles completed the first trip across the Darien Gap over primitive trails hacked out of the jungle with machetes. The basic engineering reconnaisance survey established the feasibility of a highway route across the gap. From here on out it will require mainly detailed engineering and financing of the Darien sector to complete a fully articulated system of road communications linking the Americas.

National Committee on Urban Transportation Disbands

The National Committee on Urban Transportation, sponsor of the first nation-wide technical program for community transportation planning, has disbanded.

Chairman O. W. Campbell, County Manager of Metropolitan Dade County, Florida, said in announcing the decision that the Committee's objectives have been fulfilled:

"A tremendous job has been done in providing cities and metropolitan areas with the working tools for sound transportation planning. The guides and technical manuals developed by the Committee and tested in seven pilot cities offer a practical program by which local, state and Federal officials, aided by citizen groups, can solve the growing transportation problems that plague metropolitan communities everywhere."

The Committee was organized in 1954 by representatives of six national organizations of public officials, after a report by a Presidential Highway Commission pointed out that data on urban highway needs were almost nonexistent.

Procedures for gathering and analyzing factual data were developed under the Committee's auspices by 11 subcommittees, staffed by 175 leading authorities from city, county, state and Federal governments, and from universities and consulting fields.

A planning guide, and 17 technical procedural manuals were published for the Committee by the Public Administration Service. The guide, Better Transportation For Your City, was designed for use by mayors, city managers, city councilmen, transit officials and state highway engineers. The 17 procedure manuals were intended for use by field personnel in conducting the detailed studies recommended.

These were field-tested, beginning in 1956, in San Diego, Calif., Phoenix, Ariz., Detroit, Mich., Syracuse, N. Y., Albuquerque, N. Mex., Oak Park, Ill., and Pocatello, Idaho.

"The experience in these cities fully confirmed the soundness and great value of the program," Campbell said.

"Thousands of the publications have been purchased by communities throughout the country. More than 150 communities have indicated an interest in adopting the program. Nashville and Chattanooga, Tenn., Joplin, Mo., Dayton, Ohio, and Salt Lake City, Utah are among the cities already proceeding with it.

"The Committee's work has been an unqualified success. Some cities and metropolitan areas, however, will require guidance in carrying out the recommendations, because they embody new concepts quite different from most past transportation study programs.

"It is the strong hope of the Committee, as it concludes the research phase of the activity, that some type of advisory service program will be provided for that purpose."

Members of the Committee joined in paying tribute to W. A. Rusch, Staff Director, as the man whose technical competence, skill and single minded devotion to the work, had much to do with both the content and public acceptance of the manuals.

The sponsoring organizations in the Committee include the American Municipal Association, the National Association of County Officials, the International City Managers Association, the U. S. Bureau of Public Roads, the American Public Works Association, the American Society of Planning Officials, the Municipal Finance Officers Association, the National Institute of Municipal Law Officers, and the Canadian Federation of Mayors and Municipalities.

Principal financial support for the Committee's program was provided by the Bureau of Public Roads, the Automotive Safety Foundation and the American Transit Association.

"These organizations," Campbell said, "and the American Association of State Highway Officials, also participated actively in the Committee's technical program."

Highway Research Board Lists Top Priorities

An expanded national program of highway research, extending over the next four or five years at an estimated cost of $34 million, has been recommended in a special report to the Highway Research Board, a unit of the National Academy of Sciences-National Research Council.

The report said that "a wider and deeper knowledge in every field of highway transportation is indispensable," and defined 19 broad areas of research, each of which "is adjudged to rate A-1 in importance and urgency."

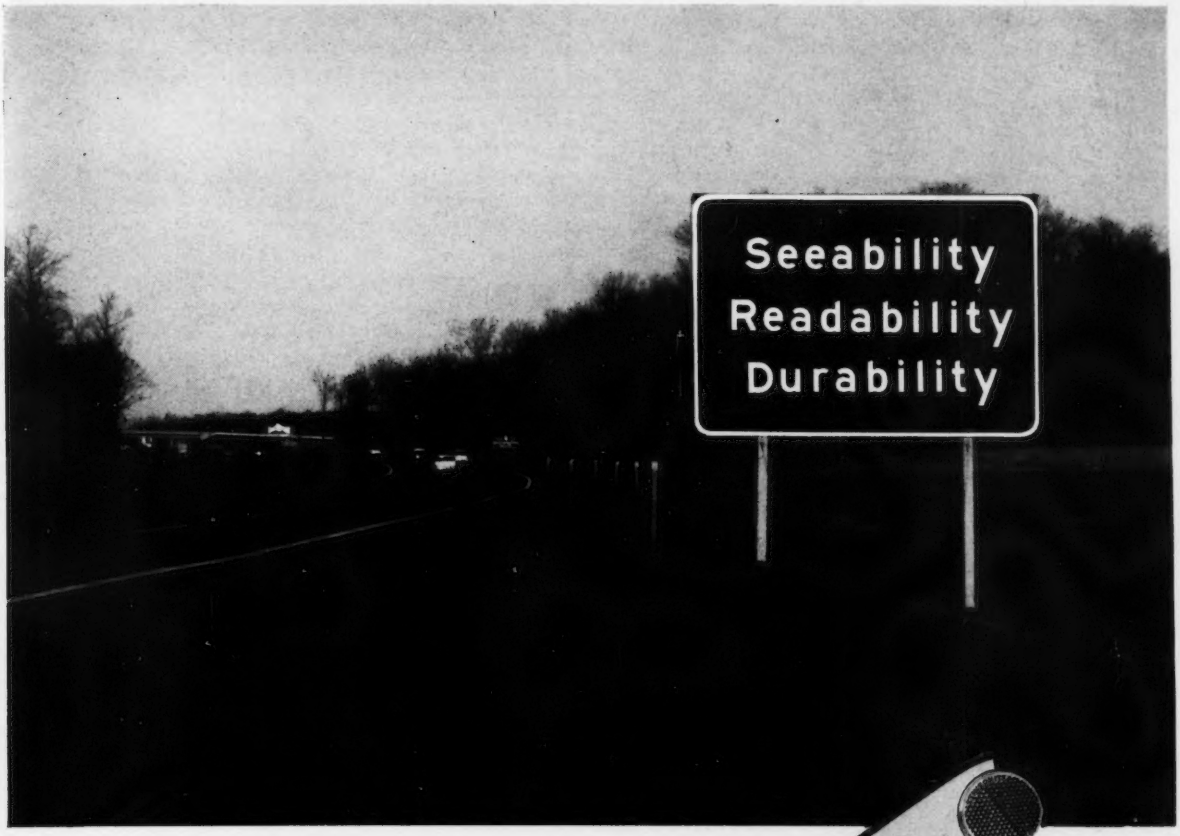
Recommended research costs range from $50,000 for studies of "Standards for Secondary and Rural Roads" up to $10 million for "Improvement of Knowledge of Aggregates and Soils," which the report said is "most urgent because of the accelerating demand for roadbuilding materials and the diminishing supply of aggregates."

The report, based on a two-year study by a five-man technical committee, suggested in connection with the research on soils that "possibly nuclear energy may transform clays and other now undesirable materials into useful aggregates."

Among other high-priority investigations urged by the committee were projects in traffic safety, road maintenance, and the use of electronic devices in simulating traffic flow, controlling vehicles on the road and simulating driver reactions behind the wheel.

The Special Committee was created by the Executive Committee of the Highway Research Board in June, 1958 "to screen all available research data, set priorities and estimate costs to get a program of highway research into motion as quickly as possible."

Chairman of the group is E. H. Holmes, Assistant Commissioner for Research of the U. S. Bureau of Public Roads. Other members are Harmer E. Davis, Director, Institute of Transportation and Traffic Engineering, University of California; W. A. Bugge, Director of Highways, State of Washington; F. V. Reagel, Engineer of Mate-



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rials and Tests, Missouri Highway Department; and Otto H. Fritzsche, State Highway Engineer of New Jersey. Mr. Fritzsche was appointed last February to replace Charles M. Noble, formerly Director of Highways in Ohio.

The committee's report said that expanded research in this field has become critically urgent because highway transportation in the United States "has become more than a factor in the economy; it has become a part of the American way of life. The economic structure is utterly dependent on it."

Current expenditures for highway research are estimated at $17.8 million annually by all agencies (excluding related industrial research privately financed), which the committee points out is equivalent to less than one fifth of a cent out of every public dollar spent for highway construction, maintenance, and administration.

The recommended program would increase annual expenditures by about 38 per cent.

The 19 research areas given high priority by the committee were screened from 101 specific proposals which had been obtained from committees of the Highway Research Board, member departments of the American Association of State Highway Officials, and other interested agencies and institutions.

The specific proposals, including 25 in the fields of economics, finance, and administration, and 21 dealing with road materials and construction, are set forth in an appendix to the committee report.

Another appendix lists 348 examples of use now being made of research results by the several state highway departments.

The 19 broader areas "of greatest urgency and importance" referred to above, together with the committee's estimate of cost for needed research in each area, and its suggestions regarding appropriate sources of funds, are described in Table I. In each case the source is one or more of four categories: "public," usually either federal or pooled state funds; "operating," funds regularly available to highway departments; "foundation"; and "industry."

* * *

"It is not the strength, but the duration of great sentiments that makes great men." —*Friedrick Nietzche*

TABLE I

Areas of Needed Research	Estimated Cost Over 4 or 5 Yrs.	Suggested Source of Funds*
Controlling development of land in vicinity of freeway interchanges	$ 200,000	P, F
Design, traffic control, and spacing of ramps and interchanges	500,000	P, O
Intensive investigation of accidents	2,000,000	P, F, I
Comprehensive study of passenger transportation in metropolitan areas	1,000,000	P, F
Comprehensive study of freight transportation by motor vehicle in rural and urban areas	500,000	P, F
Translation of the results of the AASHO road test in Illinois to conditions in other states	5,000,000**	O, P
Snow and ice removal or treatment	1,000,000	P, O
Improvement of highway maintenance	750,000	O
Improvement of knowledge of aggregates and soils	10,000,000	P, O, I
Improvement of techniques for forecasting traffic and revenues	250,000	P, F, O
Sharpening of figures of tangible road user benefits and development of method for appraising benefits now called intangible	500,000	P, O
Conceptual study of non-user and community benefits of highway construction in relation to user benefits	1,000,000	P or F, O
Warrants for lighting freeways	1,000,000	O, P, I
Standards for secondary and local roads	50,000	P, O
Development of driving simulator	3,500,000	P, F
Electronic control of vehicles	3,000,000	P, I
Analysis of the interactions of road and vehicle	500,000	P, I
Simulation of traffic flow	3,000,000	P, O
Improvement of motor vehicle administration	250,000	P, F

*P = Public; O = Operating; F = Foundation; I = Industry
**(research phases only)

NY Thruway Adopts Uniform 60-MPH Limit

The New York State Thruway Authority has adjusted its speed limit regulations to make them conform, effective June 1, to state policy for other portions of the Interstate Highway System.

Authority Chairman R. Burdell Bixby announced a speed limit on most of the Thruway, effective June 1, for all vehicles except tandem-trailer trucks of 60 miles per hour. The maximum for tandem-trailer units remains at 50.

The Authority action in adopting a uniform 60 MPH limit for all vehicles except tandem-trailers was recommended and endorsed by the state police.

The uniform 60 MPH limit has been established by the State Traffic Commission on virtually all segments of the limited-access Interstate System within the state. The Commission told the Thruway Authority that "our general policy is that the speed limit on the Interstate Highway System will be 60 MPH," and added:

"Uniform traffic speed would seem desirable in that it would reduce the number of passing maneuvers and, hence, the potential hazards associated with such maneuvers. Limited data we have, or have seen, concerning speeds on the Thruway would indicate that 60 MPH is a reasonable speed limit."

The old Thruway speed limit generally was 60 miles per hour for passenger vehicles and certain buses, and 50 MPH for other vehicles. Lower speeds are posted in some areas.

The 50 MPH maximum for commercial vehicles was adopted by the Authority prior to the opening of the

Thruway's first toll section in 1954. The truck limit was fixed at 50 MPH originally at the request of many trucking executives, who now urge the 60 MPH maximum on the ground that a uniform speed for all vehicles tends to reduce congestion and passing maneuvers and thereby promotes safer operations.

The Authority retained the 50 MPH limit for tandem-trailers because the rules and regulations for such vehicles include specifications for brakes, hitches, safety chains and other equipment based on that maximum speed.

In adopting the uniform 60 MPH speed limit, the Authority emphasized that lower limits would be posted permanently on some portions of the Thruway System, and that the maximum speed would be reduced on a temporary basis during periods of hazardous driving conditions.

Fifth of Interstate System Completed

More than one-fifth of the National System of Interstate and Defense Highways is now open to traffic—8,855 miles of the 41,000-mile goal—according to Federal Highway Administrator Bertram D. Tallamy. The status of progress was compiled by the Bureau of Public Roads, U. S. Department of Commerce, from reports received from its field offices in each State, reporting as of March 31, 1960.

The Interstate System will be the nation's basic trunk highway network, serving both civilian and defense requirements and carrying about 20 per cent of the total traffic. The Federal-Aid Highway Act of 1956 required the System to be designed to accommodate the traffic needs of 1975 and assumed the completion of the System by 1972.

Of the 8,855 miles of the Interstate System now in use by motorists, 3,442 miles were completed to standards adequate for 1975 traffic, and 3,139 miles were improved to adequacy for present traffic but will need additional improvement to bring them up to the standards for 1975. Toll roads, bridges, and tunnels incorporated in the system, as permitted by law, totaled 2,274 miles.

Almost half of the mileage open to traffic, 4,114 miles, has been built or improved under the Federal-aid Interstate program, most of it on the 90-per cent Federal, 10-per cent state sharing program launched in 1956. Work on the remaining 2,467 miles was financed by the states and localities, mostly before 1956, under other programs—in many cases with Federal aid.

TABLE I

STATUS OF INTERSTATE SYSTEM AS OF MARCH 31, 1960

Mileage improved and open to traffic:		
Completed to full or acceptable standards:		
With Interstate funds	2,890	
With other public funds	552	3,442
Improved to standards adequate for present traffic but additional improvement needed to meet full standards:		
With Interstate funds	1,224	
With other public funds	1,915	3,139
Toll facilities		2,274
Total mileage improved and open to traffic		8,855
Mileage under construction with Interstate funds		4,353
Preliminary engineering or right-of-way acquisition under way		10,436
Total mileage improved or work under way		23,644

In addition to the sections open to traffic, 4,353 miles were under construction with Interstate funds as of March 31, and engineering or right-of-way acquisition was in progress on another 10,436 miles. Thus some form of work was under way or completed on 23,644 miles of the 41,000-mile system—over half of the total.

The mileage of the Interstate System improved and open to traffic has risen from 7,570 to 8,855 since January 1 of this year, an increase of 1,285 miles. Under the controlling legislation, each state receives a yearly apportionment of Federal Interstate funds for work on approved Interstate System routes. The scheduling of preliminary steps and actual construction on these routes is left to the states, subject to approval by the Bureau of Public Roads.

The general locations of the improved sections now open to traffic and those under construction, as well as the included toll facilities, are shown on the map on pages 46 and 47.

Almost $8 billion has been put to work on the Federal-aid Interstate program since the accelerated program began less than 4 years ago. Work completed since July 1, 1956, has cost $3.26 billion, of which $2.51 billion was for construction and $752 million for engineering and right-of-way acquisition. As of March 31, 1960, work estimated to cost $4.64 billion was under way or authorized, including $3.04 billion of construction and $1.60 billion of engineering and right-of-way acquisition.

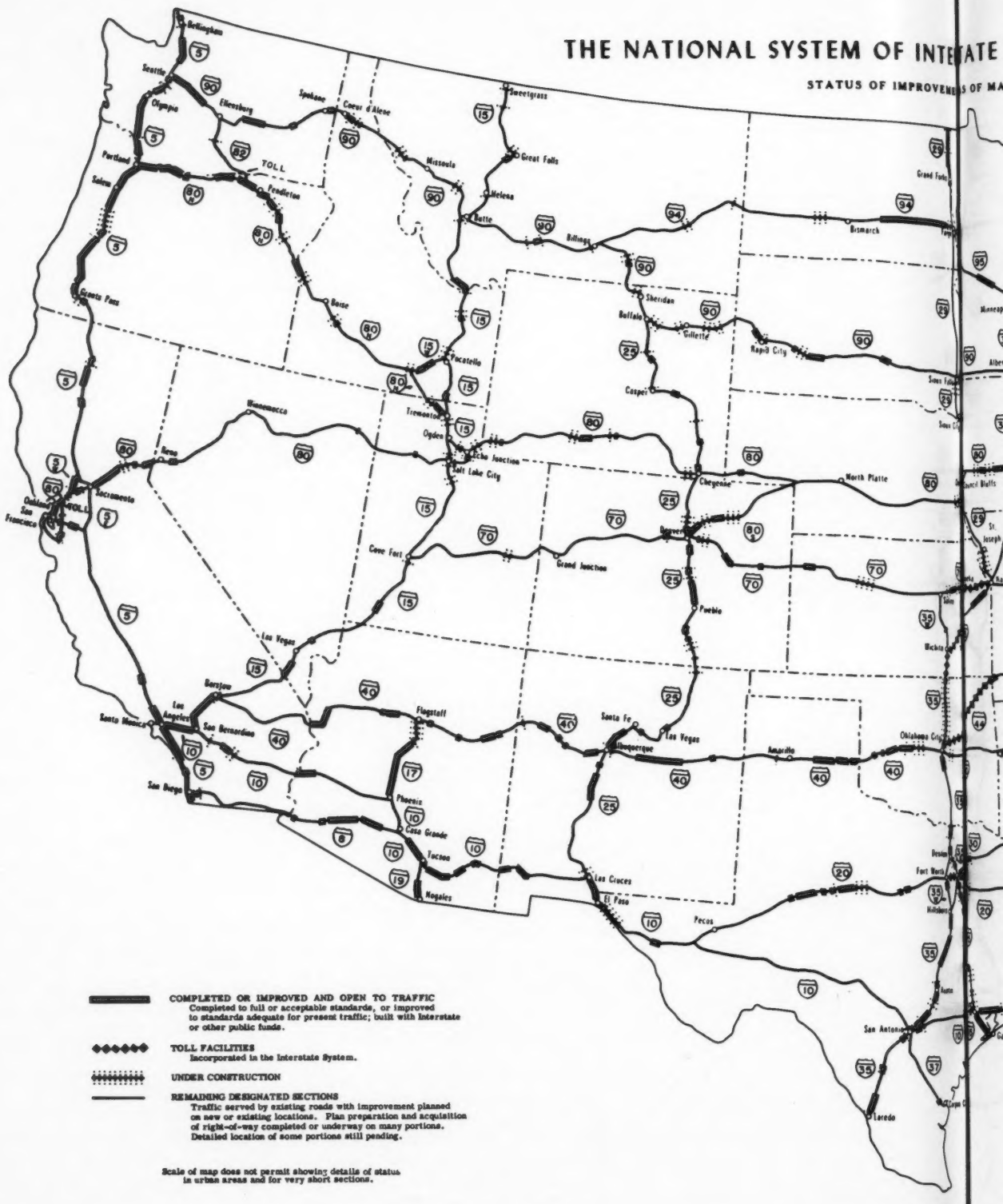
The continuing program of Federal assistance for the improvement of the Federal-aid primary and secondary highway systems and their urban extensions (the ABC program) has also made an outstanding record of progress, with almost $9 billion worth of work and almost 120,000 miles of construction contracts completed or under way.

Construction contracts involving 96,563 miles in the ABC program have been completed since July 1, 1956, at a cost of $5.84 billion; and contracts involving 22,764 miles at a cost of $2.51 billion were under way on March 31, 1960. In addition, $381 million of engineering and right-of-way acquisition work had been completed and $260 million worth of such work was under way. The ABC program is financed by the Federal government and the states on an equal-share basis.

California Announces TE Short Course for August 22-26 at LA

A short course in fundamentals of traffic engineering will be held August 22 to 26 at the University of California at Los Angeles, it has been announced by the Institute of Transportation and Traffic Engineering. Among the cooperating agencies is the Western Section of the Institute of Traffic Engineers.

The course is designed for engineers having traffic responsibilities, especially those working in smaller organizations and those new to the traffic engineering profession. Experienced en-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STATUS OF IMPROVEME S OF MA
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Grand Forks
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Sioux City
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Sacramento
Oakland
San Francisco
TOLL
Denver
Cove Fort
Grand Junction
Pueblo
Las Vegas
Barstow
Los Angeles
Santa Monica
San Bernardino
Flagstaff
Santa Fe
Albuquerque
Las Vegas
Amarillo
Oklahoma City
Wichita
San Diego
Phoenix
Casa Grande
Tucson
Nogales
Las Cruces
El Paso
Pecos
Fort Worth
Abilene
San Antonio
Laredo
COMPLETED OR IMPROVED AND OPEN TO TRAFFIC
Completed to full or acceptable standards, or improved to standards adequate for present traffic; built with Interstate or other public funds.
TOLL FACILITIES
Incorporated in the Interstate System.
UNDER CONSTRUCTION
REMAINING DESIGNATED SECTIONS
Traffic served by existing roads with improvement planned on new or existing locations. Plan preparation and acquisition of right-of-way completed or underway on many portions. Detailed location of some portions still pending.
Scale of map does not permit showing details of status in urban areas and for very short sections.

F INTERSTATE AND DEFENSE HIGHWAYS

IMPROVEMENTS OF MARCH 31,1960

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gineers, however, will also find the course useful as a refresher and a survey of current techniques.

Instructors for the course will be Norman Kennedy, James H. Kell, and Wolfgang Homburger, all of the Institute of Transportation and Traffic Engineering of the University of California. Subjects scheduled for the one-week program deal with various studies, speed zoning and control, signs and signals, parking, channelization, one-way streets, street systems, urban transportation and traffic engineering organization.

For information, write to ITTE, University of California, Berkeley 4, California. Registrations should be sent directly to University Extension, University of California, Los Angeles 24, California, together with a check for $35.

ASF Provides Traffic Fellowship

For the third successive year, the Automotive Safety Foundation of Washington, D.C. is providing a $2,000 fellowship for graduate study in the field of highway traffic administration at Michigan State University.

Announcement of the fellowship was made by the School of Police Administration and Public Safety and the Highway Traffic Safety Center at Michigan State University, where the special curriculum plan in traffic administration was developed to provide professionally trained people for traffic safety operations at state and municipal levels. This program, offered only at Michigan State University, includes a four-year undergraduate program which leads to a bachelor of science degree and a graduate program with a master of science degree. Both include selected courses from many departments of the university and are designed to provide career people to give vigorous leadership to the traffic safety movement.

Applicants from any part of the United States are eligible for the ASF fellowship. Requirements for this advanced study program include a bachelor's degree, high scholastic ability, and work or study experience in the field of highway traffic administration.

Last year's fellowship was awarded to Sgt. Thomas H. Milldebrandt, public information officer for the Arizona Highway Patrol. He is now completing his work in police administration with special emphasis on public education.

Robert M. Wray

Robert M. Wray (Mem., ITE) died in Arlington, Virginia on May 20 after a short illness.

At the time of his death he was a highway engineer attached to the Office, Chief of Transportation, Department of the Army, in Washington, a position he had held for the past four years. Earlier he had been for ten years with the Kentucky Department of Highways engaged in traffic engineering work. When he left Kentucky to come to Washington, he was assistant director of the Division of Traffic.

Wray, a native of Martinsville, Virginia, attended Virginia Polytechnic Institute and the University of Kentucky. He was a registered professional engineer in Kentucky.

While in Kentucky, he was active in work of the Louisville Safety Council and the Kentucky Society of Professional Engineers. He served on various Institute technical committees, and was an active member of the Washington (D.C.) Section of the Institute of Traffic Engineers.

Personal

Ecker Named Professor At George Washington University

John B. Ecker (Mem., ITE) has been named professor of engineering administration at George Washington University, located in Washington, D. C. This position is in the graduate engineering administration program in GW's School of Engineering, which offers the degree of Master of Engineering Administration. The program, which has been in effect since 1954, now has some 350 students enrolled.

Ecker, recently doing consulting work, was for many years connected with the local transit system in Washington, resigning in 1956 with the title of vice-president and general manager. In the last year he has spent considerable time out of the country, including a major urban traffic survey for a private firm in Bangkok, Thailand.

In his new assignment, to which he brings a broad background of experience, Professor Ecker will be teaching several courses next year. In addition, and as a prime responsibility, he will set up a clinic for teaching the principles of administration and management to engineers, scientists, supervisory and middle-management personnel who do not have either the time or educational background to enroll in the accredited program.

John B. Ecker

Petersen Appointed Staff Engineer for ITE Technical Fund

Stephen G. Petersen (Jun. Mem., ITE) has been appointed staff engineer at the ITE headquarters office. In this position he will serve as the staff man for the newly-organized Technical Research and Development Fund as well as becoming secretary of the Institute's Technical Council.

Petersen comes to the Institute from the New Jersey Bureau of Traffic Safety, where he has been Principal Traffic Engineer. He came to the New Jersey department in 1957 after completing the Yale Bureau course with the class of '57. Earlier he had worked for the Clarkeson Engineering Co. in Boston and in Watertown, N. Y.

A native of New York, Petersen attended Rensselaer Polytechnic Institute where he received the degree of Bachelor in Civil Engineering in June, 1953.

Mr. Petersen assumed his new duties in Washington on July 1.

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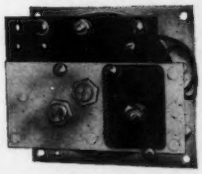

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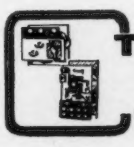

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Stephen George Heading Twin Cities Study

Stephen George, Jr. (Assoc. Mem., ITE) has been placed in overall charge of the Twin Cities Area Transportation Study. This appointment followed the resignation of Chester C. Burdick, who had headed the study since March 1958. Mr. Burdick, who retired from the Bureau of Public Roads in 1957, has entered a "second retirement" and has moved to Florida.

George, formerly assistant director in charge of the traffic phase of the study, joined the staff in 1959 from San Diego, where he was assistant transportation engineer.

The Twin Cities study started in May of this year its series of high speed electronic computer analyses. The study is expected to conclude late in 1960 with publication of the final reports.

Humphreys Named Chairman of NHUC

The election of H. E. Humphreys, Jr., Chairman of the Board, United States Rubber Company as Chairman of the Board of Governors of the National Highway Users Conference was announced at a luncheon of the Eighth Highway Transportation Congress held in May in Washington.

Elected as Vice Chairmen were Arthur M. Hill, Director and Chairman, Executive Committee, The Greyhound Corporation, and President of the National Association of Motor Bus Owners and Herschel D. Newsom, Master of the National Grange. A former Master of the National Grange, Louis J. Taber was renamed Secretary-Treasurer.

Title Changes

Willard W. Fryhofer—is now Division Engineer with the Bureau of Public Roads in St. Paul, Minnesota; was Regional Design Engineer with the U. S. Bureau of Public Roads in Kansas City, Missouri.

Kenneth B. Johns—is now Director of the Division of Traffic, Kentucky Department of Highways in Frankfort; was Assistant Director.

New Publications

An Informational Guide for Lighting Controlled Access Highways

American Association of State Highway Officials, 917 National Press Building, Washington 4, D.C. 1960. 14 pp. $0.25.

A new publication, prepared by the Committee on Planning and Design Policies of AASHO, discusses the matter of lighting on controlled access highways. After a section defining terms, the pamphlet sets forth certain warranting conditions for continuous lighting and interchange lighting. While admitting that definite criteria are not available, the publication suggests a number of cases in which lighting is considered to be warranted, and then provides a summary of guide values for such items as the level of illumination, uniformity of illumination, location of luminaires at interchanges, location of standards, and other installation items.

The Engineering Index

75th edition. The Engineering Index, Inc., 29 West 39th Street, New York 18, N. Y. 1532 pp., bound. $70.00 postpaid.

This publication contains over 39,100 annotations of articles reviewed in some 1,700 publications of engineering, scientific, and technical societies; engineering and industrial periodicals, and publications of government bureaus; engineering experiment stations, universities, and other research organizations. Selection of articles appearing in these publications is made on the basis of how they deal with the art and science of engineering. Articles on pure science, economics, commerce and trade, editorials, news items, notices of meetings, trade announcements, etc., are omitted if not considered of primary importance. The Engineering Index is arranged under 249 "field of interest" divisions of engineering. 12 pages are devoted to a list of technical publications received by The Engineering Societies Library and reviewed by The Engineering Index. 96 pages contain an index of the authors of articles reviewed. 710 technical publications reviewed come from 44 countries and about 1,000 from the United States.

Highway Research in the United States

Special Report 55. Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C. 1960. 119 pp. $2.80.

This is the long-awaited report prepared in response to a resolution of the Executive Committee of the Highway Research Board requesting that a committee of top research men in the highway field screen all available research data, set priorities and estimate costs to get a program of highway research into motion as quickly as possible.

The report itself is reviewed in a news item in this issue of TRAFFIC ENGINEERING.

Effects of Traffic Control Devices

Bulletin 244. Highway Research Board, 2101 Constitution Avenue, Washington 25. D.C. March 1960. 95 pp. $1.80.

This bulletin contains five papers presented at the 38th Annual Meeting of the Highway Research Board, as follows:

"Effect of Curb Parking on Intersection Capacity," by Anthony J. Galioto, reports the results of a quantitative evaluation study to show the effects on intersection capacity of varying lengths of clear distance adjacent to an intersection.

"Effect of Edge Striping on Traffic Operations," by I. L. Thomas, Jr., and W. J. Taylor, Jr., is a study of the effect on vehicle placement of pavement edge lines on 24- and 20-ft 2-lane pavements and on 4-lane divided highways having 12-ft lanes in one direction and 10-ft lanes in the other.

"Effectiveness of Symbols for Lane Control Signals," by T. W. Forbes, Edward Gervais, and Terrence Allen, reports on laboratory tests which showed a consistent advantage for the "red X" and the "green-arrow-up" to indicate prohibited and permitted lane use, respectively, when mounted over the lanes. These produced the desired motorist reactions in actual traffic.

"Some Principles of Freeway Directional Signing Based on Motorists' Experiences," by David W. Schoppert, Karl Moskowitz, Slade F. Hulbert, and Albert Burg, reports a study that had as its specific objectives: 1. To determine the signing and marking aids sought by motorists in the use of freeways, particularly in urban areas; 2. To determine how well existing standards and practices provide these aids and what, if any, changes could be reasonably be made in existing practices to provide the aids sought by motorists.

"Effect of Raising Speed Limits on Urban Arterial Streets," by Eugene V. Avery, reports on measurements of the effects of the establishment of reasonable and enforceable speed limits by extensive before-and-after studies of the speed characteristics.

Strictly Business

Traffic Recorders Announced

A traffic recorder that produces a punched-tape record especially designed for translation into punched-card form has been announced by the Fischer & Porter Company, Warminster, Pa.

The new recorder "Traffic Operation Punch" maintains a running total of traffic and records the total on a binary coded paper tape every 15, 30, or 60 minutes. The tape can be converted into punched cards, punched computer tape, or typewritten form with an F_P translator, completely eliminating manual data handling. For instance, a month's readings recorded at 15-minute intervals can be translated into punched cards in about 15 minutes. The translator also allows the program to be varied to meet the requirements of different computers. Because data translation is automatic, many more points can be surveyed with no additional personnel.

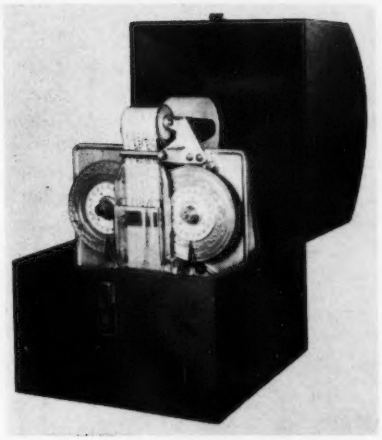
The recorder accepts signals from any type of detecting element, such as treadle, pneumatic tube, radar, electric eye, or sonic detector.

The operation of the traffic recorder is simple. Signals from a sensing element operate electrical contacts that drive a pulse motor, which in turn is geared to two coded discs. The discs, through a code represented by raised portions on their surfaces, translate the rotational information into punched information on the paper tape. The pulse motor and the two coded discs on the front of the unit are geared in such a fashion that 1000 cars will produce one revolution of the right hand wheel. The gearing arrangement between the right and left hand wheels are, in turn, 100:1.

The raised sections on the discs translate the rotational information into punched information on the tape. A raised section on the disc allows a hole to be punched—a valley does not.

A clock-driven cam initiates a punching every 15, 30, or 60 minutes. The position of the wheels at the time of the punching is proportional to the total number of cars counted.

The traffic counter is available in both portable and permanent models. The portable model is powered by a



six-volt dry cell battery, resulting in a total weight of only 40 pounds. Because ball bearings are used throughout, the drain on the battery is slight—the battery will last one year at 15-minute readout intervals. The portable unit is encased in a sturdy steel case that is hinged to provide easy accessability.

The permanent unit is mounted on a sliding mechanism that allows the unit to be installed in a standard type of traffic enclosure. The slide allows the unit to be swung clear of the box to provide complete accessability. The permanent unit contains its own rectifier and will operate on standard 110-volt power.

Both the permanent and portable models can hold a year's supply of tape (at 15-minute readout intervals).

Although the recorder is designed for traffic surveys, it can record signals from any two wire contact. The unit is capable of recording 30 counts per second.

Prismo-Wald Announces New Assignments

Major changes in the distribution system of Prismo Safety Corporation, pioneer producer of reflective marking and signing materials, and Wald Industries, Inc., leading manufacturer of equipment for application of reflective materials, have been announced by John C. Horn, president of Wald Industries, and executive vice president of Prismo.

The changes involve the establishment of a marketing department to study market requirements in the traffic field and expedite the development and movement of new products from research and design through production, and the consolidation of regional and district sales into one domestic sales organization.

D. Arthur Reese, Jr., Prismo vice president and former manager of district sales was named general sales manager for both companies in the United States and Canada. The consolidation of district and regional sales to effect a more unified sales effort was made necessary by a rapidly expanding product line, and the demands created by technological developments taking place in the traffic field, Horn said.

John O. Gehrett, Prismo vice president and former manager of regional sales, heads the newly formed marketing department, and continues in charge of trans-world sales in Europe, Central and South America. Horn said that establishment of the new department is designed to assure continued maintenance of high product quality control, and simultaneously to reduce by 30 to 50 per cent the lead time required for product development.

The changes, Horn explained, reflect the emphasis the two companies are placing upon research and development of new products for the rapidly growing traffic safety field, and the coordination of sales efforts to meet the growing demands for these products throughout the world.

Letter to the Editor

May 25, 1960

Sir:

The recent announcement that a test section on a grade separation is undergoing tests of painted speed change lanes indicates well-taken concern toward providing a "color association" with the demand for driver attention to a required maneuver.

Upon a closer analysis, however, I am tempted to question the wisdom in the use of "yellow", which is a color now available for a special purpose. For several years I have been vehemently opposed to the use by some states of one color (white or yellow) for all standard pavement markings with the resultant lessening of "color association." In the State of Florida the predominant color happens to be yellow (perhaps identified with sunshine or oranges!).

It has always been my contention, based on the "Manual of Uniform Traffic Control Devices," that yellow should convey a particular prohibitive message, and, except where used for a passing restriction in the other direction, is tantamount to a physical barrier and should never be touched by tires; i.e., islands, gores, parking prohibition, no-passing zones, etcetera.

The application of traffic engineering principles on existing pavement often dictates the use of islands or medians, but in locations where physical barriers (three-dimensional: buttons, mushrooms, curbing, etc.) cannot be used, a definitely-inferior, difficult-to-see, two-dimensional, painted island must offer to motorists a "color association" that will partially substitute for lack of the target value and meaning of a physical barrier.

If "yellow" is indiscriminately used for the pavement markings over which a person normally drives (ramp surface, stop bars, arrows, word messages, even huge directional markings for pilots!) the impact of "yellow" to give the "color association" of a prohibition (keep-off) is lost.

Should we not follow the foresight and wisdom of those traffic engineers responsible for the creation of the "Manual" and seek to follow a meaningful, uniform use of paint colors?

ROBERT L. FREEMAN
Traffic Engineer,
Florida State Road Department

PAVEMENT MARKING ECONOMIES ON OHIO TURNPIKE

By Benjamin H. Bowman, Traffic & Safety Engineer, Ohio Turnpike Commission

The striping operation on the Ohio Turnpike, painting two lines at once.

The Ohio Turnpike Commission experienced a reduction of pavement marking costs in 1959 by revising their large truck striper so that the centerline and lefthand edgeline could be applied in one simultaneous operation. Not only was the pavement striping period shortened, with obvious savings, but Turnpike patrons enjoyed an additional safety factor in that they were guided by freshly painted lines at an earlier time than normal, and before the heavy summer travel period.

The completed striping job on the Ohio Turnpike.

All mainline traffic lanes were completely marked by June 19th, which is an early date for pavement marking programs to be completed in a Northern state. Mainline painting on the Ohio Turnpike consists of a dashed 6″ wide centerline, with two 4″ wide continuous edgelines in each directional roadway. Twenty thousand gallons of paint, and sixty tons of drop-on glass beads, were used for one complete pavement painting application.

The actual revision of the large truck striper, which was originally designed to apply single or multiple lines at one location, at the rear of the striper, consisted of: 1. Building an outrigger to apply paint and beads at the left and right rear corners of the striper, just outside of the rear wheel tracks; 2. The installation of a pressure glass bead tank on the striper proper, to supply a constant flow of beads to all paint guns; 3. The installation of dual controls in the truck cab so that the driver could drive from either the left or the right side, depending upon which line was being painted; 4. The rearrangement of the long guide on the front of the striper so that it could be moved across the front of the striper from one side to the other.

Experience has taught that to get a straight painted line, the striper must have all wheels upon the pavement proper. Any operation where two wheels move on the shoulder, and two on the pavement, cannot result in a straight paint line, as the striper is bound to experience some variance in elevation on the shoulder side, thereby causing a weaving line of paint application. While all concrete pavement edges on the Ohio Turnpike appear to be very straight, it was found that these edges, when used as a guide, are not as satisfactory as the sawed concrete joint in the center of each directional roadway. By adjusting the position of the driver, the outrigger, and the front guide, all painted lines, regardless of location, are applied with the straight sawed center joint as the guiding element to follow.

When the two paint lines are being applied at one time it is possible to apply one thousand gallons of paint in a day's operation. This particular type of pavement paint application lends itself well to turnpikes and other expressways with divided roadways, such as the new interstate highway system, where the pavement widths are constant for long distances. There are two good reasons why the left edgeline is applied simultaneously with the centerline, instead of painting the right-hand edgeline with the centerline. The two reasons are as follows: 1. The one directional roadway lends itself more easily to the closing of the passing lane for paint drying time, rather than closing the driving lane. Traffic is handled more easily and more safely in this manner, as less lane changing by traffic is necessary; 2. There are no breaks in the lefthand edgeline, as all traffic leaves and enters the roadway on the right. Traffic entering and leaving thus does not pose a problem while the paint on the centerline is drying.

All striping operations are, of course, carried on with the striper moving with traffic. The right, or outside edgeline, is applied as a single operation, using the right outrigger gun only and does not require the closing of a lane to traffic during the paint drying time. Except for the placement of a limited number of "WET PAINT" signs over this outside edgeline no additional wet paint line protection is necessary.

One annual application of high grade paint will supply good lines that show up well the next spring. However, the painting must be accomplished quickly, and as soon as weather permits in the spring, if the largest possible number of drivers are to benefit by having the most effective painted guide lines in place for the summer season.

AMBER SIGNAL *(Continued from page 20)*

We also wish to express our appreciation to Dr. L. R. Hafstad for his continued interest and support of this work as well as for a number of interesting suggestions. We are indebted to Dr. S. Silverman, Office of Naval Research, for obtaining some amber-light durations in the Washington, D. C., area and to Miss Diana C. Fortine and Mr. R. Morison for similar observations in Los Angeles.

References

1. T. M. Matson, W. S. Smith, and F. W. Hurd, *Traffic Engineering*, McGraw-Hill Book Company, Inc., 1955, p. 326.
2. *Traffic Engineering Handbook*, edited by Henry K. Evans, Institute of Traffic Engineers, New Haven, 1950.
3. *Uniform Vehicle Code*, National Committee on Uniform Traffic Laws and Ordinances, Washington, D. C., 1956, p. 100.
4. *Manual on Uniform Traffic Control Devices for Streets and Highways*, Public Roads Administration, Washington, D. C., 1948, p. 107; see also the 1954 Revisions to this Manual, p. 6.

TRAFFIC ASSIGNMENT

(Continued from page 33)

partment additions make it possible to incorporate one-way streets into the network. The system has been used to assign morning peak hour volumes, evening peak hour volumes, off peak volumes and 24 hour volumes all by direction. Here also, provision is made for time-ratio diversion assignment and the so-called all-or-nothing method where 100% of the movement is assigned to the minimum path in a system which includes the freeways. The Minnesota system will also accommodate a maximum of 4000 nodes.

Selected Link Assignment

There is one additional feature that is common to both systems that has proven to be very useful to the engineer. This has been called selected link assignment. After an assignment has been completed, the engineer may designate selected links for which he wishes further analysis. The problem may be that assigned volumes are greater than facilities can reasonably be designed to accommodate or he may want to investigate weaving volumes or he may have some other interest. The program will assign only the movements involved in the selected links to the entire network and also provide, for each selected link, the origin of each movement, the destination of each movement, the link by which each movement entered each selected link and the link by which each movement left each selected link. This information allows the engineer to make changes in the proposed freeway system (sometimes far removed from the selected links) to relieve critical situations.

For further information relative to these programs, contact the Division of Development, Office of Operations, Bureau of Public Roads, Washington 25, D. C.

Coming Events

August 14-17—AMERICAN PUBLIC WORKS ASSOCIATION—
Public Works Congress and Equipment Show, New York Coliseum, New York City. Contact: APWA, 1313 East 60th Street, Chicago, Ill.

September 11-16—ILLUMINATING ENGINEERING SOCIETY—
National Technical Conference, Penn-Sheraton Hotel, Philadelphia, Penna. Contact: IES, 1860 Broadway, New York City.

September 12-16—INSTITUTE OF TRAFFIC ENGINEERS—
30th Annual Meeting, Edgewater Beach Hotel, Chicago, Ill. Contact: ITE, 2029 K St. N.W., Washington 6, D. C.

September 19-22—INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION—
Annual Meeting, Astor Hotel, New York City. Contact: Irvin Shulsinger, IMSA, 130 West 42nd Street, New York 36, N.Y.

September 26-30—FIFTH INTERNATIONAL TRAFFIC STUDY WEEK—
Nice, France. Contact: M. H. Perlowski, Secretary to the OTA/PIARC/IRF Joint Committee, 32 Chesham Place, London S.W.1, England.

October 9-12—AMERICAN TRANSIT ASSOCIATION—
Annual Meeting, Sheraton Hotel, Philadelphia, Penna. Contact: ATA, 355 Lexington Ave., New York, N. Y.

October 9-13—AMERICAN SOCIETY OF CIVIL ENGINEERS—
Annual Convention, Statler Hotel, Boston, Mass. Contact: ASCE, 29 West 39th St., New York, N. Y.

October 17-21—NATIONAL SAFETY COUNCIL—
National Safety Congress and Exposition, Hilton, Congress and other hotels, Chicago, Ill. Contact: NSC, 425 N. Michigan Avenue, Chicago 11, Ill.

November 28-December 2—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
Annual Meeting, Sheraton-Cadillac Hotel, Detroit, Mich. Contact: AASHO, 917 National Press Bldg., Washington 4, D.C.

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CHICAGO TRANSIT

(Continued from page 18)

Under the terms of the Metropolitan Transit Authority Act, which, together with the city of Chicago franchise ordinance, govern CTA operations, rates of fares must be sufficient at all times to pay for the costs of operation, as well as the cost of capital improvements. Consequently, Chicago's local transit riders are bearing virtually all the cost of providing local transit, although transit is now generally recognized to be a public service similar to other public services such as police and fire protection, highways, health and sanitation, parks and playgrounds.

In more than ten years of CTA operation, Chicago has witnessed transit service improvements and transit equipment modernization unparalleled in any similar period in the city's history. A record-breaking total of $130,500,000 has been spent or committed for modernization of equipment and other facilities. All of the old red streetcars, many of them 50 or more years old, have been scrapped; so have all of the ancient wood and wood-steel rapid transit cars.

Service, particularly rapid transit service, has been substantially improved, although the draining of patronage by automobile competition or by changed activity patterns has forced the pruning of dead or dying short branches of the rapid transit system. Even so, the rapid transit system, offering a service generally free from street traffic interference, is giving the private automobile vigorous competition.

It is now unquestionably clear, however, that the Chicago metropolitan area's need for many more miles of grade-separated, off-the-street transit extensions and costly improvements in existing facilities, cannot be financed by Chicago Transit Authority riders.

It is equally obvious that private capital cannot be persuaded to provide financing for sorely needed transit improvements and extensions.

Therefore, if the job is to be accomplished, it must be carried forward as a joint project by the public agencies that are vitally concerned with the welfare and economic progress of the Chicago metropolitan area.

There exists ample justification for extending public financial aid to transit. Local transit, in particular rapid transit, is serving the primary highway function, that of moving people, and is doing it much more efficiently and economically than the private automobile.

Use of public funds to help transit to do a better job will not only drastically reduce the terrific economic waste resulting from traffic congestion, but will actually conserve highway funds in the long run by reducing the need for costly expressways and costly parking lots and garages to store users' automobiles during the working hours of the day.

1. First step—Join stores, office buildings and CTA subway facilities at first basement level to permit travel in the downtown area free from street traffic interference and under complete protection from inclement weather.

Initially these shopping arcades would tie together under a continuous roof all of the establishments on both sides of State Street and some buildings fronting on Dearborn Street which is adjacent and parallel to State Street between Randolph and Van Buren Streets. There would also be an arcade at the first basement level along the south side of Randolph Street, between Wabash and Michigan Avenues, connected with the Illinois Central and South Shore stations, the Prudential Building and the Grant Park underground garage east of Michigan Avenue.

The estimated cost of the first step of this phase of the program is roughly estimated at $5,500,000. This does not include the cost of relocating the city-owned underground utilities. This modest outlay is in sharp contrast to the more than $90,000,000 of new shopping center projects now being constructed or planned in suburban areas.

Second step—Expand the substreet network to the proposed new Civic Center, to City Hall-County Building, and office buildings farther west in the central district. The cost of this phase of the program has not been estimated.

2. Construct multi-story Park-'N'-Ride garages at outlying rapid transit stations and terminals with direct connections by ramps to the transit facilities and nearby expressways and local streets. Five Park-'N'-Ride garages with a total capacity of 23,000 autos are suggested initially at an estimated cost of $46,000,000, as follows:

Congress-Desplaines, Forest Park terminal of the new West Side subway, 6,000 parking spaces; Howard Street, north terminal of the North-South "L"-subway route, 3,000 spaces; Stony Island Avenue at 63rd Street, terminal of the Jackson Park branch of the North-South "L"-subway route, 5,000 spaces; at 40th Street between Michigan and Indiana Avenues, 3,000 spaces; at the South Expressway and 63rd Street, the city terminal of the Calumet Skyway, and connected with the Englewood branch of the North-South "L"-subway route, 6,000 spaces.

3. Improve and extend rapid transit service farther out from the central district through CTA's 20-year, $315,000,000 program for improvement and extension of off-street, grade-separated rapid transit.

Rapid transit extension and improvement projects in CTA's 20-year program include: Rail rapid transit in the Northwest Expressway from a connection with the Logan Square "L" to an initial terminal near Canfield Avenue and the city limits with a future extension to O'Hare International Airport; rail rapid transit in the South Expressway from 30th Street to 103rd Street on the Calumet branch of the expressway, and to the city limits and 119th Street on the Blue Island branch; bus rapid transit in the Southwest Expressway from its connection with the South Expressway near Cermak Road to Cicero Avenue near Pershing Road; construction of a grade-separated connection between the Lake Street rapid transit route and the West Side subway in Congress Expressway near the west city limits to permit routing of trains via the subway; extension of the Englewood branch of the North-South "L"-subway from 63rd Street and Loomis Avenue to Cicero Avenue in the Clearing industrial district; crosstown rapid transit in the right-of-way of the proposed Crosstown Expressway from a connection with the Northwest Expressway to a connection with the proposed Englewood-Clearing extension; elevation of the ground-level section of Lake Street rapid transit route from Laramie Avenue to Harlem Avenue; elevation of ground-level section of Ravenswood rapid transit route from Rockwell Avenue to the terminal at Kimball and Lawrence Avenues; elevation of ground-level section of Douglas Park rapid transit branch between Kildare Avenue, Chicago, and 56th Avenue, Cicero, and an elevated extension west to Harlem Avenue.

4. Construct ten Park-'N'-Ride garages or parking lots at or near selected suburban railroad stations. Initial capacity would be at least 15,000 parking spaces. These parking facili-

ties would be located near existing business centers in Waukegan, Highland Park, Barrington, Arlington Heights, and Wheaton on the various North Western routes; in Aurora and Hinsdale on the Burlington route; in Blue Island on the Illinois Central and Rock Island routes, in Homewood on the Illinois Central route and near Hammond, Indiana business district on the South Shore interurban railroad. The cost of this phase of the program is estimated at $30,000,000.

Positions Available

CONTRA COSTA COUNTY, CALIFORNIA
—25 miles N.N.E. of San Francisco—

Position: Assistant Traffic Engineer in Public Works Department. Broad scope planning and analysis work for County-wide traffic engineering program.
Requirements: Degree in engineering and two years of civil engineering experience, one of which must be in traffic engineering.
Substitution: Traffic engineering experience may be substituted for college, OR Traffic engineering graduate study may be substituted for experience.
Salary: $6672-$8112.
Recommended for 7-1-60: $6908-$8521.
Apply: Contra Costa County, Civil Service Commission, Box 710, Martinez, California.

CINCINNATI, OHIO

Position: Traffic Control Engineer 3, in progressive city traffic engineering organization. To perform advanced engineering work in traffic design, traffic and parking studies and research, and traffic operations and control, depending on assignment.
Qualifications: Degree in civil or electrical engineering or similar engineering degree, with specialization in traffic control methods and procedures. Minimum of two years experience in traffic engineering.
Salary: $7,558-$8,392 annually, with annual increases. Paid vacation, retirement, hospitalization and other fringe benefits.
Apply: Mr. W. D. Heisel, City Personnel Director, City of Cincinnati, Cincinnati 2, Ohio.
Applications must be received prior to August 15, 1960.

PORTLAND, OREGON

Position: Engineer II—Traffic.
Requirements: Minimum two years college with major study in civil, electrical or related engineering.
Salary: $465 month to $541 month after two years.
Benefits: Retirement program, sick and vacation leave.
Apply: Portland Civil Service Board, Room D, 234 S. W. Clay, Portland, Oregon.

SAN DIEGO, CALIFORNIA

Position: Traffic and Transportation Engineer, to plan, organize and direct the activities of the Transportation and Traffic Engineering Division of the Engineering Department. Will be responsible for advanced transportation and traffic research and planning, as well as traffic operations for the City of San Diego and other cooperating jurisdictions. The Division has a staff of 31 persons and a 1960-61 budget of nearly $200,000. Population of San Diego is 554,000.
Requirements: Equivalent to college degree in Civil Engineering or a related field and five years of responsible traffic engineering experience, including two years in transportation research.
Salary: $909-$1,105 per month, plus liberal benefit program including fully paid medical insurance.
Apply: City Personnel, Room 453, Civic Center, San Diego 1, California, by September 2, 1960.

CONSULTING FIRM

Position: Planning Engineer—for interesting and demanding work on comprehensive engineering and economic investigations for the planning of industrial, commercial and residential developments, transportation facilities and major civil works. Opportunity for diversified experience and progressively increasing responsibility with consulting engineering firm (New York City).
Requirements: Graduate civil engineer with education and experience in traffic engineering. Prefer at least 5 years responsible experience in diversified aspects of engineering and planning projects. Applicant must have ability to express complex problems and solutions in concise written reports of professional character. Include complete personal resume, availability and salary requirements in first letter.
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Institute Affairs

Board of Direction Meets in Missouri

The Institute Board of Direction held its spring meeting May 9 & 10 in Columbia, Missouri. A number of matters important to the membership were acted upon. Following is a summary of the most significant.

(1) *New Members and Transfers*—The Board elected 36 new Juniors, 12 new Associates, and two new Members. Applications were declined from three applicants for Junior and four for Associate.

Nineteen transfers from Junior to Associate were approved, and five transfers from Associate to Member. One request for transfer from Associate to Member was turned down.

A full list of new members and transfers is published in this issue.

(2) *New Affiliate*—The Board voted to extend an invitation to Russell I. Brown, president of the Insurance Institute for Highway Safety, Washington, D.C., to become an Affiliate.

(3) *New Sustaining Organizations*—Four new Sustaining Organizations were invited to contribute to the Technical Research and Development Fund: Federal Sign and Signal Co.; General Railway Signal Co.; Kar-Trol Signal Co.; Rockwell Manufacturing Co. (Dual).

(4) *Consulting Fees*—A special committee was authorized to look into the possibility of preparing a schedule of traffic engineering services and fees of consultants. This had been suggested by several consulting members of the Institute.

(5) *Membership Changes*—Plans were approved for a questionnaire to all members on the subject of membership grades and qualifications. The membership will be asked to vote informally on a number of specific changes, including the creation of a grade of "student member" and the possibility of a new "super" grade. The questionnaire will be prepared by the Board Committee on Membership Qualifications and will be mailed to the entire mailing list soon.

(6) *Constitutional and By-Laws Amendments*—Five proposals to amend the Constitution and By-Laws were adopted by resolution of the Board. These will all be on the agenda of the business meeting in Chicago and will be subject to a later mail ballot by the entire membership. A formal announcement will be made soon to all members, but the gist of the proposed amendments is as follows:

(a) The Nominating Committee would be enlarged to provide one member from each District each year, instead of the present plan of one member from each District in which a Director is to be elected.

(b) The Institute year for administrative purposes would be changed to coincide with the fiscal year, which means that officers elected at the Annual Meeting in the fall would not actually take office until January 1, and would serve for a full twelve months.

(c) A "life membership" would be created, providing that members 65 years of age or over who have paid dues as a Member or Associate Member for 25 years or more would be excused from further dues payments but would retain all membership privileges.

(d) The section relating to expulsion of members from the Institute would be amended to provide that eight votes for expulsion are necessary in the Board of Direction instead of the present five votes.

(e) The present references to Sustaining Organizations would be changed to refer to "Participating Organizations" and to their contributions to the Technical Research and Development Fund.

(7) *Student Chapters*—Two actions in regard to Student Chapters were taken by the Board. The first provides that advisors of Student Chapters do not have to be full Members of the Institute, thus making it possible to organize Chapters where there may be only an Associate Member on the faculty. The other was a decision to waive the registration fee at the Annual Meeting in Chicago for members of a Student Chapter.

(8) *New Section Authorized for Florida*—With the consent of the Southern Section, the Board authorized a new Section for the State of Florida. The officers are: Edward A. Mueller, president; George H. Kunde, vice president; and John W. Barr, secretary-treasurer. The mailing address for the secretary is 7273 SW 53rd Avenue, South Miami 43, Florida. This brings the total number of Sections to 15.

(9) *Ban on Local Sustaining Organizations*—The Board reaffirmed its stand against "local sustaining organizations" which contribute on an annual or other regular basis to the support of Local Sections. This type of operation is completely contrary to Board policy. It was pointed out, however, that this did not prohibit contributions to a specific meeting or for a specific purpose.

(10) *Multiple Section Membership*—The Board adopted as a policy the Workship recommendation in reference to membership in more than one Section. This provides that a member

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shall be permitted to join the Section of his choice, but that if he is already a member of one Section, he must obtain permission of that Section to join another.

(11) *Joint Meeting of Section Officers and the Board in September*—For the past several years the Board and Section Officers have met during the Annual Meeting, usually for breakfast. This year the Board, feeling that previous meetings have been too short and that there would be mutual advantages in a longer discussion, has set aside the entire morning of Thursday, September 15, from 8 to 11 o'clock. It is planned to operate on a planned agenda which will cover many items of Section-Institute relationships. All Section officers are urged to attend.

(12) *Proposed Local Section Manual*—The Board has for some time been anxious to have a manual of operations for Local Sections. At long last, such a document now exists, at least in first draft form, in the office of the Executive Secretary. Copies will be reviewed by members of the Board in the next few weeks, and after revision will be distributed to Section officers for their review and comments. The subject will be one of the agenda items for the meeting in Chicago on Thursday morning.

(13) *District Boundaries* — The Board's Committee on District Boundaries was asked to present a report at the September meeting on the desirability of creating a seventh membership district.

(14) *Enlargement of Staff*—Employment of a staff engineer was authorized, to serve as secretary of the Technical Council and as staff man for the Technical Research and Development Fund. An announcement of the selection of this man appears elsewhere in this issue.

(15) *Workshop Recommendations*—Almost the entire list of recommendations arising from the Workshop last year was reviewed by the Board, and action taken on them. The Board was interested to note that in a large number of cases, the points recommended were already being handled in one fashion or another. Some of the earlier action reported in this report was taken in response to Workship recommendations, for instance.

(16) *Inventory Awards*—Although the Board had earlier voted to issue awards this year in connection with the Annual Inventory program, it was decided that there was enough uncertainty about the future of this activity to warrant an expression of opinion from the entire membership. To guide the Board in making a decision for next year, it was agreed that a questionnaire should be circulated to the Institute membership to determine the majority opinion on this point. This mailing will be made in the next few weeks.

(17) *Insurance Eligibility Dates*—Approval was given a request of the Insurance Trustees to create two standard eligibility dates for new members and transfers as far as the life insurance program is concerned. Heretofore the rules set dates in relation to the date of election and transfer which resulted in confusion and pro-rated premiums. Now all changes in insurance for transfer cases and all new policies for new members will be effective either August 15 or February 15, whichever comes first after the date of election or transfer.

MEMBERSHIP APPLICATIONS

The Institute of Traffic Engineers welcomes applications from qualified traffic engineers, but does not desire as members persons who are unqualified. Listed below are the names of those from whom applications for membership or transfer in grade have been received since the last published list. Institute members are urged to review this as soon as possible and immediately inform the Executive Secretary's office if names of people are found who are known to be unqualified for ITE membership or transfer.

New Applications

ADAMS, Donald Richard
Traffic Engineer III—Bureau of Street Traffic, 321 North LaSalle Street, Chicago 10, Illinois—for ASSOCIATE.

BRAMMER, Donald Doty
Traffic Engineering Planner—City, Coral Gables City Hall, P. O. Drawer 34-1549, Coral Gables, Florida—for JUNIOR.

DAVIS, Merritt McGregor
Assistant Professor—University of Toronto, Toronto, Ontario, Canada—for ASSOCIATE.

HEALD, Kenneth L.
Programming Engineer—Iowa State Highway Commission, Computing Center, Ames, Iowa—for ASSOCIATE.

KLOAC, George E.
Traffic Engineer III—Bureau of Street Traffic, 321 North LaSalle Street, Chicago 10, Illinois—for ASSOCIATE.

LAKS, Edward Edmund
Roads Engineer—Corporation of the District of Burnaby, 4545 East Grandview Douglas Highway, Burnaby 2, B.C., Canada—for ASSOCIATE.

MOREHEAD, Ted L.
Application Engineer—Econolite Corporation, 8900 Bellanca Ave., Los Angeles 45, California—for ASSOCIATE.

TAYLOR, George Edmondson
Junior Traffic Engineer—DeLeuw, Cather & Co. of Canada, Ltd., 1491 Yonge Street, Toronto, Ontario, Canada—for JUNIOR.

WILDERMUTH, Bruno Roland
Traffic Engineer—City Planning Division, Department of Public Works, Zentralplatz 49, Biel, Switzerland—for JUNIOR.

Applications for Transfer

ANDREWS, Basil Rupert
Director, Department of Traffic Engineering—City, P. O. Box 1038, Savannah, Georgia—for MEMBER.

BROWN, Gerald Richardson
Assistant Urban Studies Engineer—Ontario Department of Highways, Parliament Buildings, Toronto, Ontario, Canada —for ASSOCIATE.

DeSHAZO, John Jenkins, Jr.
Director of Streets and Traffic—City, Box 1971, Amarillo, Texas—for ASSOCIATE.

LASH, Michael
Planning and Programming Engineer—U. S. Bureau of Public Roads, 248 Farmington Avenue, Hartford, Connecticut—for ASSOCIATE.

LEVINSON, Herbert S.
Associate, Wilbur Smith and Associates—495 Orange Street, New Haven, Connecticut—for MEMBER.

MacDONALD, Bruce Briggs
Senior Civil Engineer (Traffic)—New York State Traffic Commission, 95 Washington Avenue, Albany 1, New York—for MEMBER.

McLEROY, Charles E., Jr.
Senior Traffic Engineer—City of Corpus Christi, P. O. Box 1622, Corpus Christi, Texas—for ASSOCIATE.

Yearbook Changes

ABRAHAMSON, R. T. (Junior)
Assistant Traffic Engineer, City, Box 1971, Amarillo, Texas. DRake 2-8329.

BAILEY, Robert (Associate)
Traffic Superintendent, Traffic Engineering Department, City, 428 Sixth Ave., E., Calgary, Alberta, Canada. AMherst 3-3520. SEND MAIL: 53 Cawder Drive, Calgary, Alberta, Canada.

BATES, Leland H. (Junior)
Traffic Engineer, City Traffic Division, Room 327 City Hall, St. Louis 3, Missouri. MAin 1-5560, ext. 615.

BATTS, Herman M. (Member)
City Traffic Engineer, City Hall, Des Moines, Iowa. CHerry 4-2181, ext. 232.

BERMAN, Jack (Associate)
Assistant Highway Planning Engineer, Port of New York Authority, 111 Eighth Avenue, New York 11, New York. ALgonquin 5-1000, ext. 8063.

BLINDAUER, Harlan H. (Junior)
Traffic Engineer, Meissner Engineers, Inc., 401 Court Street, Reno, Nevada. FAirview 9-0851.

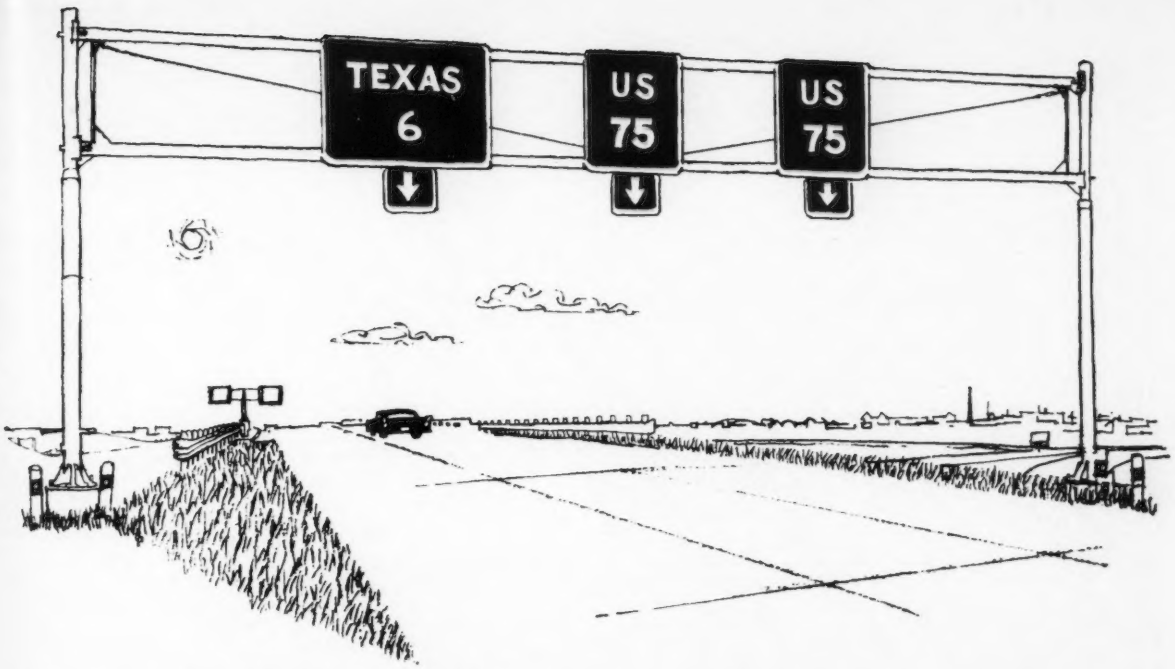
BOORSE, J. W., Jr. (Junior)
Assistant Traffic Operations Engineer, City, 1003 City Hall Annex, Philadelphia 7, Pennsylvania. LOcust 8-5950.

BROWN, Russell I. (Affiliate)
President, Insurance Institute for Highway Safety, 1710 H Street, N.W., Washington 6, D.C. STerling 3-1671.

BUNTE, William Franklin (Junior)
Traffic Engineer III, City Traffic Division, Room 327 City Hall, St. Louis 3, Missouri. MAin 1-5560, ext. 714.

BURTON, H. Robert (Member)
Director, Traffic Division, Department of Public Works, 129 Adelaide Street, W., Room 401, Toronto 1, Ontario, Canada. EMpire 2-5711, ext. 771. SEND MAIL: 56 Langmuir Cres., Toronto 9, Ontario, Canada.

(Continued on page 62)



New KIMPREG 8000 gives color permanence to highway signs!

NOW! Color-fast acrylic overlaid plywood is available in Green and White! Made with new Kimpreg 8000—a fiber-resin saturated and coated material developed by Kimberly-Clark to be combined with Kimpreg 2010—it is used for the prefinished surfacing of highway signs.

Many states, now using Kimberly-Clark's high density overlay (Kimpreg 2010) have reported amazing results in all kinds of weather-and-damage resistance. Now, with new Kimpreg 8000, permanent color is achieved. Kimpreg 8000 is currently available in standard Interstate Highway Green and White; also Red and Blue.

For names of manufacturers and suppliers in your area—together with detailed literature and case histories, write: Kimberly-Clark Corporation, Department TE-70, Neenah, Wisconsin.

For the story of how KIMPREG is used, turn the page. DFPA TESTED QUALITY →

Kimberly-Clark

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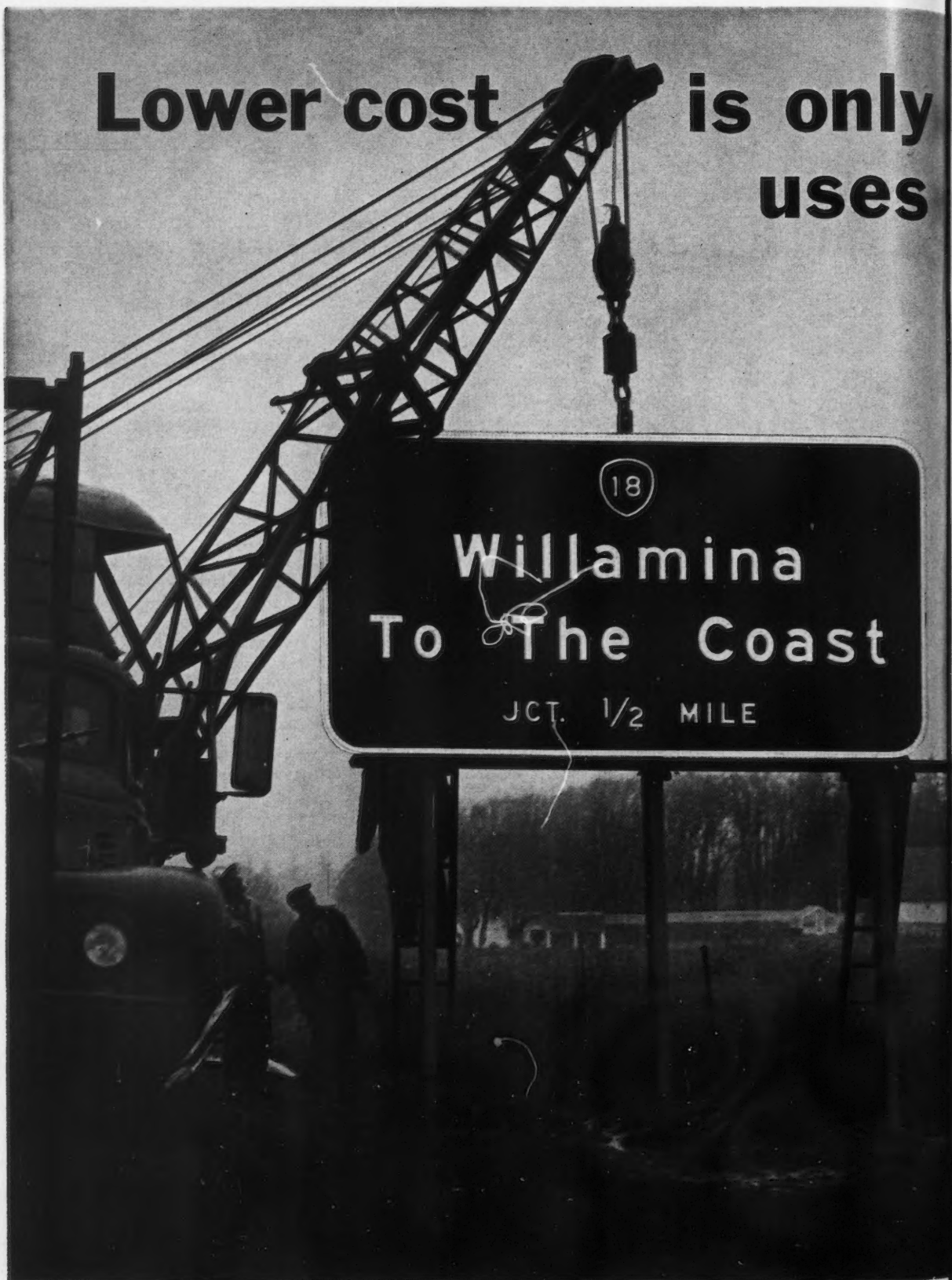

New colorfast green overlaid plywood with reflective button legend and border is used for green background direction signs.

one reason why Oregon signs of overlaid plywood

MODERN REFLECTORIZED OVERLAID PLYWOOD signs do a better job for the taxpayer as well as the motorist in Oregon.

State highway officials estimate the overall cost of an overlaid plywood sign installation averages 20 percent less than other acceptable materials. Savings are based on lower basic material costs, faster fabrication and finishing (neither sign face nor back is painted; reflective legend is applied direct)—plus elimination of the need for special back framing on signs up to 40 square feet in area.

But lower cost is only part of the story. Basically, Oregon uses overlaid plywood because it makes a strong, good-looking sign that stands up under prolonged weathering and deliberate or accidental abuse.

All told, the state maintains over 100,000 signs; 47,000 informational, 20,000 warning and 35,000 regulatory. Ninety percent are reflectorized, with reflective legend and border applied directly to the overlaid plywood surface. Key directional signs are illuminated. Black high density panels are used for warning and regulatory signs. New color-fast green acrylic overlaid plywood is used for green background direction signs to conform to national color coding on Interstate and other highways.

FOR MORE INFORMATION (detailed specifications, application data, etc.) write:
DOUGLAS FIR PLYWOOD ASSOCIATION
TACOMA 2, WASHINGTON
—an industry-wide organization devoted to research, promotion and quality control
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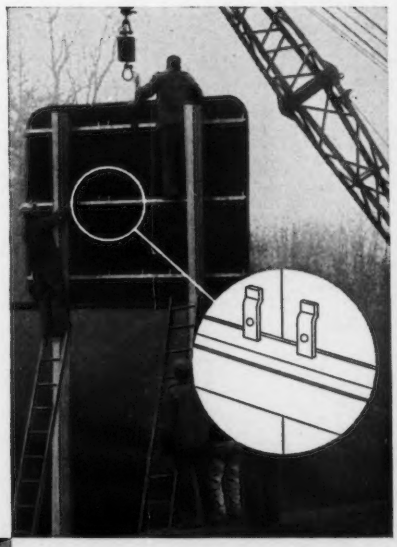
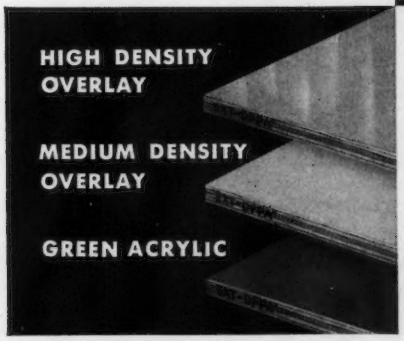


New panelized sign system used on recent Oregon installations employs standard aluminum girts and special clips. System is highly economical, permits flexibility in sign sizes and shapes. Developed by Douglas Fir Plywood Association, it meets all AASHO standards.



Medium density overlaid plywood is for plain painted signs; **high density** requires no paint protection and permits direct application of reflective sheeting. **New acrylic overlay** comes in green and white for signs with painted or reflectorized legend.

YEARBOOK CHANGES

(Continued from page 58)

CANTILLI, Edmund J. (Associate)
Traffic Engineer II, Traffic Engineering Division, Port of New York Authority, 111 Eighth Avenue, New York 11, New York. ALgonguin 5-1000, ext. 736.

CARPENTER, J. C. (Member)
Eventide, 2015 East Tenth Avenue, Topeka, Kansas.

CARROLL, Robert B. (Associate)
Traffic Engineer, Department of Traffic Engineering, City Hall, 241 W. South Street, Kalamazoo, Michigan. FIreside 5-7111, ext. 45.

COOL, Stanley David (Junior)
Traffic Engineer II, Traffic Division, Michigan State Highway Department, Stevens T. Mason Building, Lansing (Sta A), Michigan. IVanhoe 5-8144, ext. 2564. SEND MAIL: 6035 Lake Drive, Haslett, Michigan.

DEEN, Thomas B. (Associate)
Applied Science Representative, IBM Corporation, 1100 Church Street, Nashville, Tennessee. SEND MAIL: 1108 Sparta Road, Nashville 9, Tenn.

DELANEY, Desmond Joseph (Associate)
Chief Engineer, Traffic Commission of Victoria, Exhibition Building, Melbourne, N. 3, Victoria, Australia. 34-0201. SEND MAIL: 19 McGregor Street, Canterbury E. 7, Victoria, Australia.

EASLEY, George W. (Junior)
Traffic Technician, Virginia Department of Highways, 1221 East Broad Street, Richmond 19, Virginia. MIlton 4-4111.

ECKER, John B. (Member)
Professor Engineering Administration, George Washington University, Washington, D. C. FEderal 8-0250, ext. 251. SEND MAIL: 9311 Harrington Drive, Bethesda 14, Maryland.

EWENS, W. E. (Member)
Director, Department of Traffic, City of Hamilton, City Hall, Hamilton, Ontario, Canada. JAckson 7-0344. SEND MAIL: Box 84, R. R. No. 1, Dundas, Ontario, Canada.

FARMER, Justin F. (Junior)
Traffic & Planning Engineer, Porter & O'Brien, 1421 - 47th Avenue, Sacramento 22, California. SEND MAIL: 5413 Moddison Avenue, Sacramento, California.

FLANAKIN, H. A. Mike (Member)
Civil Engineer, Administration & Planning, Charles M. Upham Assoc., Inc., 1625 Eye Street, N.W., Washington 6, D.C. STerling 3-4588. SEND MAIL: 90/1 Paknam Road, Bangkapi, Bangkok, Thailand.

FRYHOFER, Willard W. (Associate)
Division Engineer, U.S. Bureau of Public Roads, 625 North Robert Street, St, Paul, Minnesota. CApital 2-8011, ext. 607.

GEISSLER, Ernest (Junior)
County Engineer, Lewis County Courthouse, Chehalis, Washington. SHerwood 8-4271.

GRAHAM, Keith W. (Associate)
Assistant Traffic Engineer, City, 104 S. Main, Wichita, Kansas. AMherst 2-8211, ext. 274.

HANSEN, Harold W. (Member)
Supervising Engineer (Iowa Study), Automotive Safety Foundation, 200 Ring Building, Washington 6, D.C. FEderal 8-3115. SEND MAIL: 2306 Clark Avenue, Ames, Iowa.

HENRY, Ellis C., Jr. (Associate)
Traffic Commissioner, City, Room 327, City Hall, St. Louis 3, Missouri. MAin 1-5560, ext. 714.

HENSLEY, Sam P. (Junior)
Associate Engineer & Vice President, Hensley & Associates, Inc., 209 Roswell Street, Marietta, Georgia. 7-1268.

HOBRLA, Joseph E. (Associate)
Highway Traffic Engineer, Traffic Division, Michigan State Highway Department, Stevens T. Mason Building, Lansing, Michigan. IVanhoe 5-8144, ext. 2564.

HOLSINGER, Robert George (Junior)
Assistant Traffic Engineer, Department of Public Works, City, 8425 Second Street, Downey, California. TOpaz 10361.

HUFFMAN, Jack D. (Junior)
Traffic Designer, District Office, Texas Highway Department, P. O. Box 3190, Beaumont, Texas. TErminal 2-1691. SEND MAIL: 305 Youpon Street, Silsbee, Texas.

HUPPERT, William W. (Associate)
Assistant Chief Engineer, Eagle Signal Company, Division of Gamewell Co., 202 - 20th Street, Moline, Illinois. 2-5571.

JOHNS, Kenneth B. (Associate)
Director, Division of Traffic, Kentucky Department of Highways, Frankfort, Kentucky. CApitol 7-2231, ext. 293.

JONES, Floyd I. (Associate)
Assistant Traffic Engineer, City, 210 Monona Avenue, Room 501, Madison 9, Wisconsin. ALpine 7-3761, ext. 581.

JONES, John E. (Associate)
Senior Highway Analyst, Planning & Traffic Division, New Jersey State Highway Department, 1035 Parkway Avenue, Trenton 8, New Jersey. TUxedo 2-3000. SEND MAIL: 282 Clamer Road, Trenton 8, New Jersey.

JOYNER, Harvey R. (Junior)
Research Assistant, Civil Engineering Department, North Carolina State College, Raleigh, North Carolina. TEmple 4-5211, ext. 549.

KOLOM, Lester L. (Associate)
Traffic Engineer IV, Operations Division, Bureau of Street Traffic, Room 709 City Hall, Chicago 2, Illinois. RAndolph 6-8000, ext. 768.

LITCHFORD, James O. (Associate)
Design Engineer, Charles M. Upham Associates, Inc., 1625 Eye Street, N.W., Washington 6, D. C. STerling 3-4588. SEND MAIL: USOM/UAR, c/o American Embassy, Cairo, Egypt, U.A.R.

MARTZ, William C. (Junior)
Traffic Control Engineer, Division of Traffic Engineering, City, 101 West Third Street, Dayton, Ohio. BAldwin 2-3441. SEND MAIL: 2065 Lakewood Drive, Dayton 20, Ohio.

MAYER, Peter A. (Junior)
Traffic Designer, Traffic Engineering Division, Arizona Highway Department, 206 S. 17th Street, Phoenix, Arizona. ALpine 8-6313, ext. 276.

MICHAEL, Harold L. (Member)
Assistant Director, Joint Highway Research Project, Purdue University, Civil Engineering Building, Lafayette, Indiana. 92-2111.

MOE, Robert I. (Junior)
Assistant District Traffic Engineer, Milwaukee Metropolitan District, State Highway Commission of Wisconsin, 794 North Jefferson Street, Milwaukee 2, Wisconsin. BRoadway 1-6934.

MYATT, John C. (Member)
Deputy State Highway Engineer, Department of Transportation, 869 Punchbowl Street, Honolulu 13, Hawaii. 50511-347.

PARKER, Roy Alfred (Junior)
Assistant Traffic Engineer, City, 112 South 9th Street, Phoenix, Arizona. ALpine 8-7313, ext. 284.

PEARSON, Frederick C. (Junior)
Traffic Engineer, Wilbur Smith & Associates, 495 Orange Street, New Haven, Connecticut. UNiversity 5-2191. SEND MAIL: 222 Cherry Hill Circle, Branford, Connecticut.

PEARSON, Russell C., Jr. (Associate)
Assistant Traffic Engineer, City, 817 Tenth Street, Sacramento 14, California. GIlbert 2-5041, ext. 270. SEND MAIL: 2307 51st Avenue, Sacramento 22, California.

PLINE, James L. (Junior)
Signal & Lighting Engineer, Idaho Department of Highways, P. O. Box 879, Boise, Idaho. 4-5811, ext. 263. SEND MAIL: 2520 Fry Circle, Boise, Idaho.

POLLARD, William Sherman, Jr. (Member)
Partner, Harland Bartholomew & Associates, 317 North 11th Street, St. Louis 1, Missouri. GArfield 1-2107.

POWELL, Berkeley Douglas (Associate)
Assistant Road Commissioner, Riverside County Road Department, c/o County Court House, Riverside, California. OVerland 3-4000. SEND MAIL: 5632 Carson Road, Riverside, California.

PRATT, Richard H. (Junior)
Engineer, DeLeuw, Cather & Company, 1256 Market Street, San Francisco 2, California. UNderhill 1-1302.

RAUS, Juri (Junior)
Assistant Highway Engineer, Traffic Division, Connecticut State Highway Department, 24 Wolcott Hill Road, Wethersfield, Connecticut, CHapel 9-5211. SEND MAIL: 43 Ridgewood Street, New Britain, Connecticut.

RISER, Clarence E. (Junior)
District Traffic Engineer, Minnesota Highway Department, 1123 Mesaba Avenue, Duluth 1, Minnesota. SEND MAIL: 6875 Arrowhead Road, Duluth 11, Minnesota.

ROBERTSON, John N. (Associate)
Consulting Engineer, 2725 29th Street, N.W., Apartment 523, Washington 8, D. C. DEcatur 2-3980.

ROCKAFELLOW, Richard M. (Junior)
Sales Engineer, Automatic Signal Division, Eastern Industries, Inc., Regent Street, East Norwalk, Connecticut. TEmple 8-4791.

ROSEVEARE, Robert W. (Junior)
Research Assistant, Civil Engineering Department, North Carolina State College, Raleigh, North Carolina. TEmple 4-5211, ext. 549. SEND MAIL: 200 Pineview Drive, Greenville, North Carolina.

ROWAN, Neilon J. (Junior)
Assistant Professor & Assistant Research Engineer, Civil Engineering Department, A & M College of Texas, College Station, Texas. VIctor 6-5707, ext. 53.

SAAG, James B. (Associate)
Traffic Engineer, DeLeuw, Cather & Company, 150 North Wacker Drive, Chicago 6, Illinois. FInancial 6-0424. SEND MAIL: 233 Callan Avenue, Evanston, Illinois.

SINEMUS, Herman A. (Associate)
Assistant Traffic Engineer, City, 425 South Calhoun Street, Fort Wayne, Indiana. ANthony 7441. SEND MAIL: 1622 Edenton Drive, Fort Wayne, Indiana.

STEEGER, Otto Gustav (Associate)
Assistant Traffic Engineer, Montgomery County Traffic Division, County Office Building, Rockville, Maryland. POplar 2-3216. SEND MAIL: 712 Mapleton Drive, Rockville, Maryland.

STREB, Paul Lawrence (Associate)
Assistant Traffic Engineer, Division of Traffic Engineering, and Highway Planning, Department of Public Works, 245-A State Office Building, Providence 3, Rhode Island. JAckson 1-7100, ext. 581.

SUPERSAD, Jankie Nanan (Junior)
Executive Engineer, Department of Works, 1 Edward Street, Port of Spain, Trinidad. W.I. 31711. SEND MAIL: Southern Main Road, Montrose Village, Chaguanas, Trinidad, W.I.

SUTHERLAND, Ralph D. (Junior)
District Field Engineer, Bureau of Traffic, Illinois Division of Highways, 6035 N. Mt. Hawley Road, Peoria, Illinois. 2-5431. SEND MAIL: 2708 N. Victoria Avenue, Peoria, Illinois.

TISDALE, E. Dean (Junior)
Assistant Planning Engineer, Idaho State Highway Department, P. O. Box 879, Boise, Idaho. 4-3710.

TOPP, Robert M. (Junior)
Assistant Engineer, Research Department, Toronto Transit Commission, 1900 Yonge Street, Toronto 7, Ontario, Canada. LEnnox 4-9511.

VICK, Columbus Edwin, Jr. (Junior)
Graduate Research Assistant, Civil Engineering Department, North Carolina State College, Raleigh, North Carolina. TEmple 4-5211. SEND MAIL: 4116 Dover Road, Jacksonville, Florida.

WADE, Philip Edward (Associate)
Highway Analysis Engineer, Planning Division, Ontario Department of Highways, Parliament Buildings, Toronto 2, Ontario. CHerry 4-2571.

WALLACE, Robert W. (Associate)
Highway District Traffic Engineer, Virginia Department of Highways, Fredericksburg, Virginia.

WENGER, Deane M. (Associate)
Senior Traffic Engineer, Traffic Engineering Bureau, City, 274 City Hall & Courthouse, St. Paul 2, Minnesota, CApital 4-4612, ext. 458.

New Members and Transfers

Approved by the Board of Direction, May 9, 1960

TRANSFERS FROM JUNIOR TO ASSOCIATE

BAILEY, Robert
Traffic Superintendent, Traffic Engineering Department, City of Calgary, Alberta, Canada

BERGENDOFF, Raymond C.
Project Planning Engineer, Howard, Needles, Tammen & Bergendoff, Kansas City, Missouri

BERMAN, Jack
Assistant Highway Planning Engineer, New York Port Authority, N. Y., N. Y.

CANTILLI, Edmund J.
Traffic Engineer II, Port of New York Authority, New York, N. Y.

DEEN, Thomas B.
Applied Science Representative, I.B.M. Corporation, Nashville, Tenn.

GRAHAM, Keith W.
Assistant Traffic Engineer, City of Wichita, Kansas

HENRY, Ellis C.
Traffic Commissioner, City of St. Louis, Missouri

HUPPERT, William W.
Assistant Chief Engineer, Eagle Signal Co., Moline, Illinois

JONES, Floyd I.
Assistant Traffic Engineer, City of Madison, Wisconsin

PEARSON, Russell C.
Assistant Traffic Engineer, City of Sacramento, California

PRATT, Charles O.
Associate Traffic Engineer, Wilbur Smith & Assoc., New Haven, Conn.

SAAG, James B.
Traffic Engineer, De Leuw, Cather & Co., Chicago, Ill.

SINEMUS, Herman A.
Assistant Traffic Engineer, City of Fort Wayne, Indiana

STREB, Paul Lawrence
Assistant Traffic Engineer, Department of Public Works, Providence, R. I.

TILLMAN, Donald Calvin
Assistant District Engineer, Reseda, California

WADE, Philip Edward
Highway Analysis Engineer, Ontario Dept. of Highways, Toronto, Ontario, Canada

WENGER, Deane M.
Senior Traffic Engineer, City of St. Paul, Minnesota

WHISTON, Edward George
Highway Engineer, Dook County Highway Dept., Chicago, Ill.

WONG, Oliver D. K.
State Traffic Engineer, Hawaii Division of Highways, Honolulu, Hawaii

TRANSFERS FROM ASSOCIATE TO MEMBER

BATTS, Herman M.
City Traffic Engineer, Des Moines, Iowa

BURTON, Francis C.
Traffic Consultant, Scanlon-Edwin & Associates, Sante Fe, New Mexico

BURTON, Harry Robert
Director, Traffic Division, Department of Public Works, City of Toronto, Ontario, Canada

MICHAEL, Harold L.
Assistant Director, Joint Highway Research Project, Purdue University, Lafayette, Indiana

POLLARD, William Sherman, Jr.
Partner, Harland Bartholomew & Associates, St. Louis, Missouri

NEW JUNIOR MEMBERS

ABRAHAMSON, Royal T.
Assistant Traffic Engineer, City of Amarillo, Texas

BATES, Leland H.
Traffic Engineer, City of St. Louis, Missouri

BENNETT, Richard C.
Senior Traffic Engineer, D. C. Department of Highways & Traffic, Washington, D. C.

BLACKBURN, James D.
Graduate Research Assistant, N. C. State College, Raleigh, N. C.

BLINDAUER, Harlan H.
Traffic Engineer, Meissner Engineers, Inc., Reno, Nevada

BOORSE, John W., Jr.
Assistant Traffic Operations Engineer, City of Philadelphia, Pennsylvania

BUNTE, William F.
Traffic Engineer III, City of St. Louis, Missouri

COOL, Stanley David
Highway Traffic Engineer II, Michigan State Highway Dept., Lansing, Mich.

DOWNES, Donald P.
Assistant Traffic Engineer, City of New Haven, Conn.

EASLEY, George W., Jr.
Traffic Technician C, Va. Dept. of Highways, Richmond, Virginia

GEISLER, Ernest
County Engineer, Lewis County Courthouse, Chehalis, Washington

HENSLEY, Sam P.
Associate Engineer & Vice President, Hensley & Associates, Inc., Marietta, Georgia

HOLSINGER, Robert G.
Assistant Traffic Engineer, Department of Public Works, City of Downey, California

HUFFMAN, Jack D.
Traffic Designer, Texas Highway Department, Beaumont, Texas

JOYNER, Harvey R.
Research Assistant, N. C. State College, Raleigh, North Carolina

KHANNA, Tejbir S.
Assistant Director c/o Traffic Engineer, Dentral Road Research Institute, New Delhi 20, India

MARTZ, William C.
Traffic Control Engineer, City of Dayton, Ohio

MAYER, Peter A.
Traffic Designer, Arizona Highway Department, Phoenix, Arizona

MICKES, Joseph A.
Engineer Inspector I, Missouri Highway Department, Kirkwood, Missouri

MOE, Robert I.
Assistant District Traffic Engineer, State Highway Commission of Wisconsin, Wilwaukee, Wisconsin

PARKER, Roy Alfred
Assistant Traffic Engineer, City of Phoenix, Arizona

PEARSON, Frederick Carl
Traffic Engineer, Wilbur Smith & Associates, New Haven, Conn.

PLINE, James L.
Signal & Lighting Engineer, Idaho Dept. of Highways, Boise, Idaho

PRATT, Richard H.
Engineer, De Leuw, Cather & Co., San Francisco 2, California

RAUS, Juri
Assistant Highway Engineer, Connecticut State Highway Department, Wethersfield, Conn.

RISER, Clarence E.
District Traffic Engineer, Minn. Highway Dept., St. Paul, Minn.

ROCKAFELLOW, Richard M.
Sales Engineer, Automatic Signal Division, East Norwalk, Conn.

ROSEVEARE, Robert W.
Research Assistant, N. C. State College, Raleigh, N. C.

ROWAN, Neilon J.
Assistant Research Engineer & Assistant Professor, A & M College of Texas, College Station, Texas

SUPERSAD, Jankie N.
Executive Engineer, Dept. of Works, Port of Spain, Trinidad, B.W.I.

SUTHERLAND, Ralph D.
District Field Engineer, Illinois Division of Highways, Peoria, Ill.

TOPP, Robert M.
Assistant Engineer, Research Dept., Toronto Transit Commission, Toronto, Ontario, Canada

TORRES, Gilberto Lugo
Chief, Planning & Programming Section, Bureau of Traffic, Dept. of Public Works, Santurce, Puerto Rico

VICK, Columbus E.
Graduate Research Assistant, N. C. State College, Raleigh, N. C.

WERT, Robert E.
Traffic Control Engineer, City of Dayton, Ohio

YAMANAKA, Henry M.
Civil Engineer IV, Illinois Division of Highways, Chicago, Illinois

NEW ASSOCIATE MEMBERS

ANTHONY, Floyd L.
Regional Design Engineer, U. S. Bureau of Public Roads, Chicago, Ill.

CARROLL, Robert B.
City Traffic Engineer, Kalamazoo, Michigan

COPLEN, Roy I., Jr.
Maintenance Superintendent, Missouri State Highway Dept., Kirkwood, Mo.

GRIFFITH, Lincoln E.
Traffic Engineer IV., Bureau of Street Traffic, City of Chicago, Ill.

HOBRLA, Joseph E.
Highway Traffic Engineer, Michigan State Highway Dept., Lansing, Mich.

JONES, John E.
Senior Highway Analyst, New Jersey State Highway Dept., Trenton, N. J.

KOLOM, Lester L.
Traffic Engineer IV, Bureau of Street Traffic, Chicago, Illinois

OLIPHANT, David N.
Traffic Engineer, City of Salisbury, Southern Rhodesia

POWELL, Berkely D.
Assistant County Road Commissioner, Riverside County, California

ROBERTSON, John N.
Consulting Engineer, Washington, D. C.

STEEGER, Otto Gustav
Assistant Traffic Engineer, Montgomery County Traffic Division, Rockville, Maryland

WILMOT, Charles R.
Planning & Research Engineer, Department of Highways of Ontario, Toronto, Ontario, Canada

NEW MEMBERS

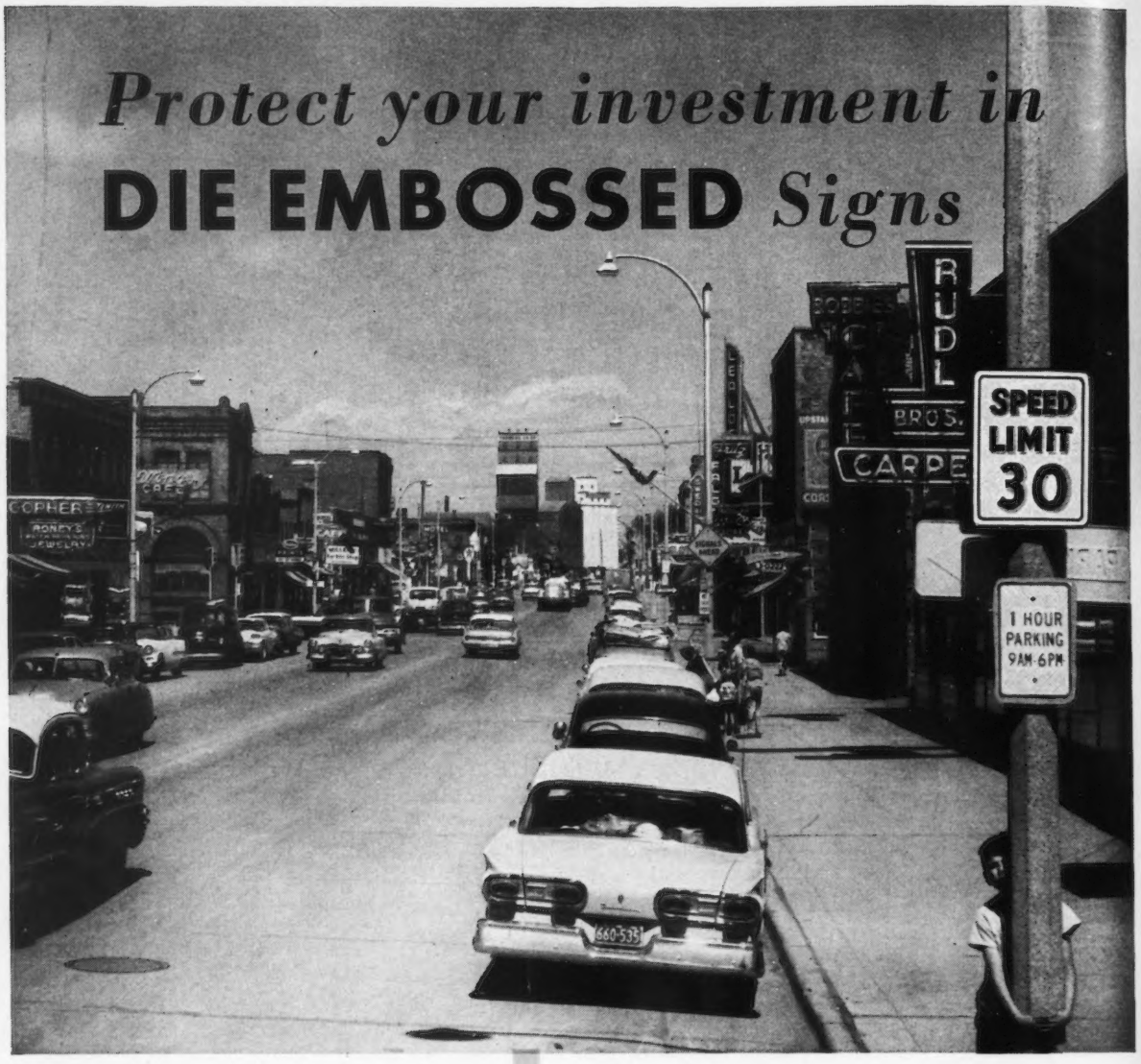
HANSEN, Harold Woodrow
Supervising Engineer, Automotive Safety Foundation, Washington, D. C.

MYATT, John C.
Deputy State Highway Engineer, Honolulu, Hawaii

NEW AFFILIATE

BROWN, Russell I.
President, Insurance Institute for Highway Safety, Washington, D. C.

Protect your investment in DIE EMBOSSED *Signs*



Die Embossed signs are easy to refinish. A new coat of paint makes the background look like new . . . a roller brings out letters and borders to their original brilliance. The job can be done in minutes while the sign remains on the post.

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- GOPHER STAMP & DIE CO., ST. PAUL, MINN.
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- LYLE SIGNS, INC., MINNEAPOLIS, MINN.
- MIRO-FLEX CO., INC., WICHITA, KANSAS
- N.S.E. SIGNS & STAMPINGS, B'HAM, ALA.

In ten thousand communities DIE EMBOSSED traffic signs have been the standard for over thirty years. Uniformity of size, shape, wording and color is assured by many manufacturers who help you protect your past investments. Strength, rigidity, angle visibility, low cost — the best for less — is yours with DIE EMBOSSED signs.

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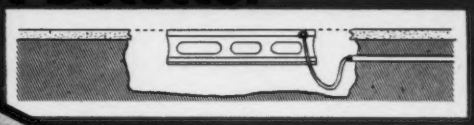
Your actuated controller is as good as its detector, specify the best . . .

. . . Traffic Signals, inc. formerly Southern Signals, inc. *actuated controllers with the exclusive Surface Mounted Magnetic Detector*



Model 242 Surface-Mounted Magnetic Detector

featuring:

- ✓ Single Lane Detection
- ✓ High Sensitivity with Sharp Cut-Off
- ✓ Dependable over wide speed range
- ✓ Completely sealed, moisture-proof cast aluminum unit
- ✓ Does not wear out—Lasts for years—Street can be resurfaced over detector.

Used with the Multi-Purpose 102A Controller

Model 102A

Semi-actuated, Volume Density if desired.

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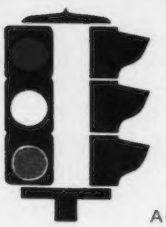

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Section News

INDIANA SECTION

The Indiana Section of the Institute of Traffic Engineers cooperated with other sponsors in the planning and operation of the 46th Annual Purdue Road School held at Purdue University April 18-21, 1960. The Indiana Section planned, and its officers conducted, the program of the separate sessions for traffic engineers held on the mornings of April 19, 20 and 21, assisted in the planning of the general session on April 20, held an annual banquet on April 19, at the Van Orman Hotel in Lafayette, and conducted a traffic engineering information room throughout the road school. This room was manned by members of the Purdue Student Chapter of ITE and Section members.

At the three separate sessions of the road school, the traffic engineers heard discussions of topics on the operations, planning and design phases of traffic engineering. The role of the traffic engineer in traffic safety (by A. E. Huber), school children crossings (by Jim White), and research in progress in traffic engineering at Purdue were discussed on Tuesday morning. The role of planning in traffic engineering, the impact of highway improvements, and the principles of location for highways in urban areas were the subjects of Wednesday morning. On Thursday morning, Prof. M. E. Harr of Purdue presented a very provocative discussion on proper design methods for highways (he suggested that a highway was analagous to a structure and could be designed the same way). This same morning a discussion on intersection channelization was led by Mr. J. D. Franklin of Grand Rapids, Michigan. The last topic of the meeting was on pedestrian malls and included the viewpoint of Toledo's experience (by Tom Major) and the viewpoint of an architect (Evans Woollen of Indianapolis).

In addition to the topics mentioned above, two of the speakers at the plan-

Speakers at the general session of the Purdue Road School Wednesday afternoon, April 20, included, left to right: David R. Levin, chief, Highway and Land Administration Division, Bureau of Public Roads, Washington, D. C., who spoke on land development and control at interchanges on interstate systems; Robert F. Van Hoef, Michigan State Highway Department, Lansing, Mich., who spoke on the use of the planner in highway development; George M. Foster, executive director, State Highway Department of Indiana, moderator; and Edward G. Wetzel, Port of New York Authority, New York City, on planning for traffic operations.

Shown left to right are W. H. Bilby, currently engineer of traffic with the State Highway Department, Indianapolis; Prof. Harold L. Michael, of Purdue, secretary-treasurer of the Indiana section, I.T.E.; and E. G. Wetzel, president of ITE. Bilby is immediate past president of the Indiana section, I.T.E.

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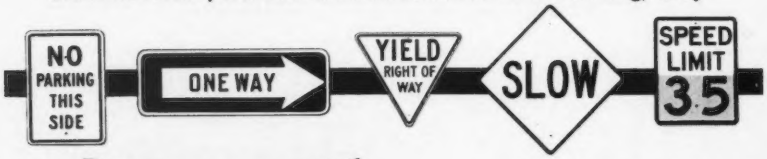

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One of the interesting features of the 46th Annual Purdue Road School was an exhibit on traffic engineering. Shown with a portion of the display on traffic signs are, left to right, W. W. Schenler, president of the student chapter of the Institute of Traffic Engineers at Purdue, and Frank S. Vukovits, engineer of traffic surveys, State Highway Department, and vice-president of the Indiana Section, Institute of Traffic Engineers. Schenler, now doing graduate work at Purdue, is assistant professor of civil engineering at Washington University, St. Louis.

ning session on Wednesday morning teamed with our National President, Ed Wetzel to present three planning topics on Wednesday afternoon's general session. Mr. Dave Levin of the Bureau of Public Roads discussed "Land Development and Control at Interchanges on Interstate Systems". Mr. Robert Van Hoef, director of the Planning Division of the Michigan State Highway Department, presented "Use of the Planner in Highway Development" and Ed Wetzel's paper was on the subject "Planning for Traffic Operations."

On Wednesday evening at the Annual Road School banquet Mr. Pyke Johnson, well known highway figure, spoke on "Mr. Average Motorist of 1960." All of the sessions were well attended and much traffic engineering information was made available to the over 1000 in attendance (about 60-75 of these were traffic engineers or interested in traffic engineering).

Seventy-two members and guests attended the ITE banquet on Tuesday evening at which National President, Edward G. Wetzel, spoke on "Traffic Engineering—A Dynamic Profession." We also were honored to have as our guests for this banquet Dean Emeritus and National Honorary Member A. A. Potter and Prof. K. B. Woods, head of the Civil Engineering School at Purdue University.

MISSOURI VALLEY SECTION

The officers of the Missouri Valley Section for the coming year are:
Mr. William J. Armstrong—President

A portion of the 125 participants in the 12th Annual Traffic Engineering Conference sponsored by the Missouri Valley Section, ITE, and the University of Missouri, and held May 11 & 12 at Columbia.

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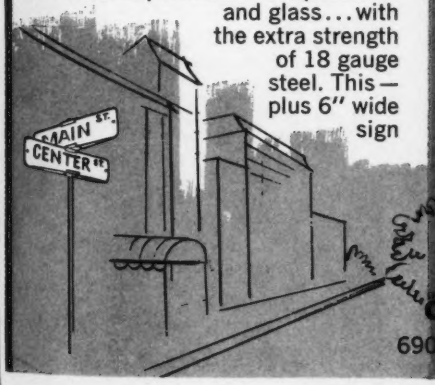

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Ellis C. Henry, Jr., St. Louis Traffic Commissioner and out-going president of the Missouri Valley Section, ITE, presides at the opening session of the Missouri Traffic Engineering Conference.

Mr. George C. Lichty—Vice President
Mr. Daniel J. Hanson—
Secretary-Treasurer
115 North Meramec Ave.
Clayton 5, Missouri

MICHIGAN SECTION

New officers elected by the Michigan Section at a meeting on May 28 are as follows:

President—Max R. Hoffman
Vice President—Harold L. Hickman
Secretary-Treasurer—
Frank A. Ronan

NEW ENGLAND SECTION

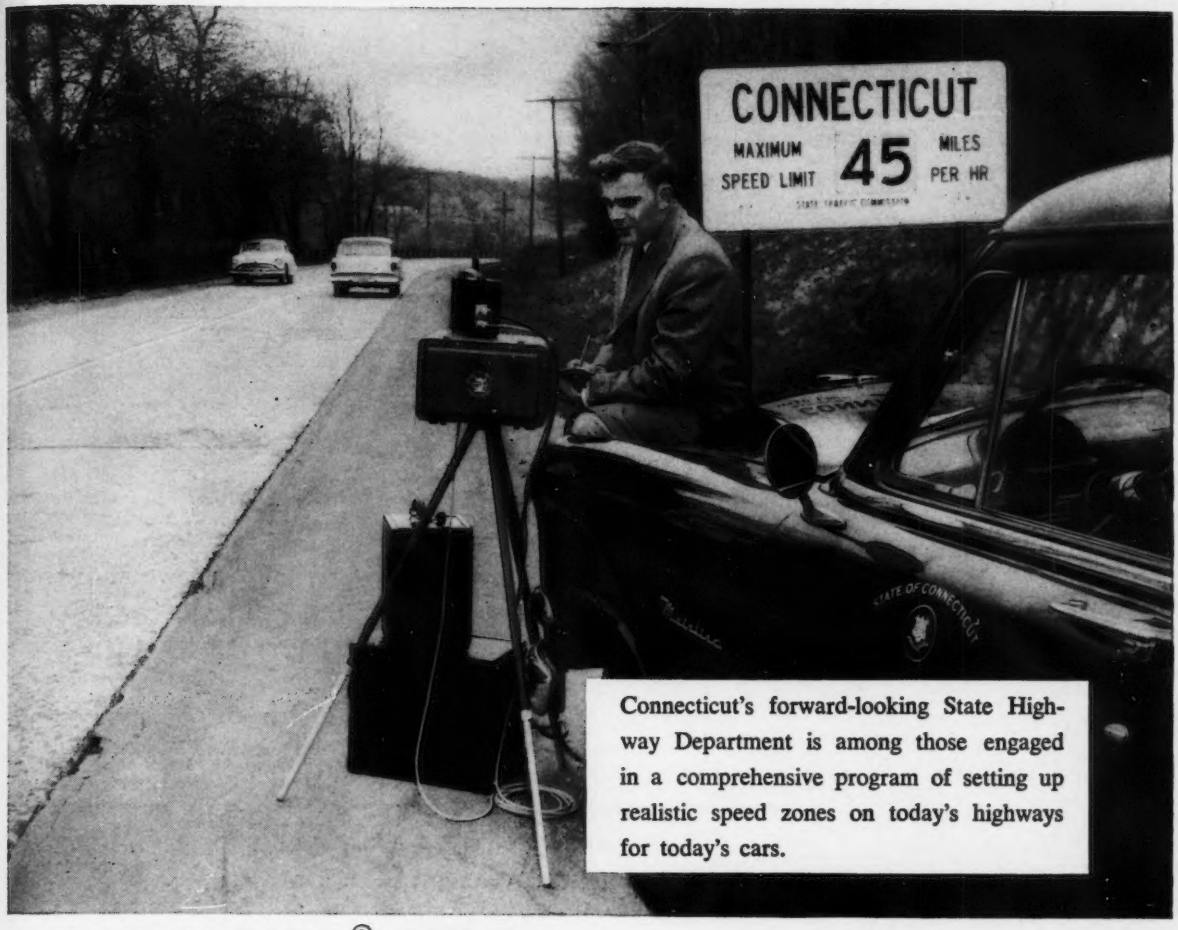
The following men were elected officers for the coming year:

William R. McGrath—President
Bernard B. Twombly—Vice President
Burton M. Rudy—Secretary-Treasurer
57 Linbrook Rd.,
West Hartford 7, Conn.

FLORIDA SECTION

The following notice received from ITE's Executive Secretary, Dave Baldwin, was music to our ears:

"The Board of Direction met on May 9 and 10, and gave full consideration to the formation of a Florida Section of the Institute. There was before the Board both the proposed Constitution and By-Laws of the Section and a letter from the President of the Southern Section indicating the full concurrence of that Section. . . . The Board, I am happy to tell you, approved the formation of the Florida Section. . . . With modifications, . . . the Florida Section Constitution and By-Laws were approved and the Section is now formally authorized . . . The Board looks forward to . . . reports of continued activity and progress by our newest Section."



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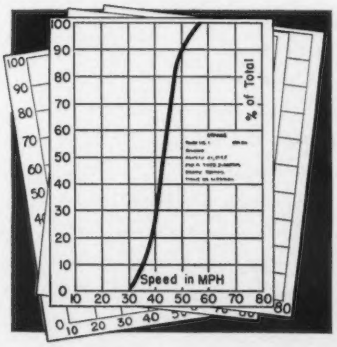

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WESTERN SECTION

Some of the top highway administrators from the western states and from the Bureau of Public Roads returned to school at the University of California April 11-13. The event was a seminar on "Urban Highway Planning and its Relation to General Urban Development," sponsored by AASHO to brief these officials on the latest thinking in city and regional planning, land economics, and transportation planning. AASHO selected the ITTE to pioneer the way by organizing the first seminar, and its steering committee has now agreed that similar seminars should be held in the other AASHO geographical regions.

The seminar, under the chairmanship of Harmer Davis, was guided by Professors Jack Kent, Mel Webber and Paul Wendt of UC, by Professor Jack Howard of M.I.T., by Al Voorhees of the Automotive Safety Foundation, and by Richard Zettel of the ITTE.

WASHINGTON (D.C.) SECTION

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William L. Carson—Vice President
Robert A. Keith—Secretary-Treasurer

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